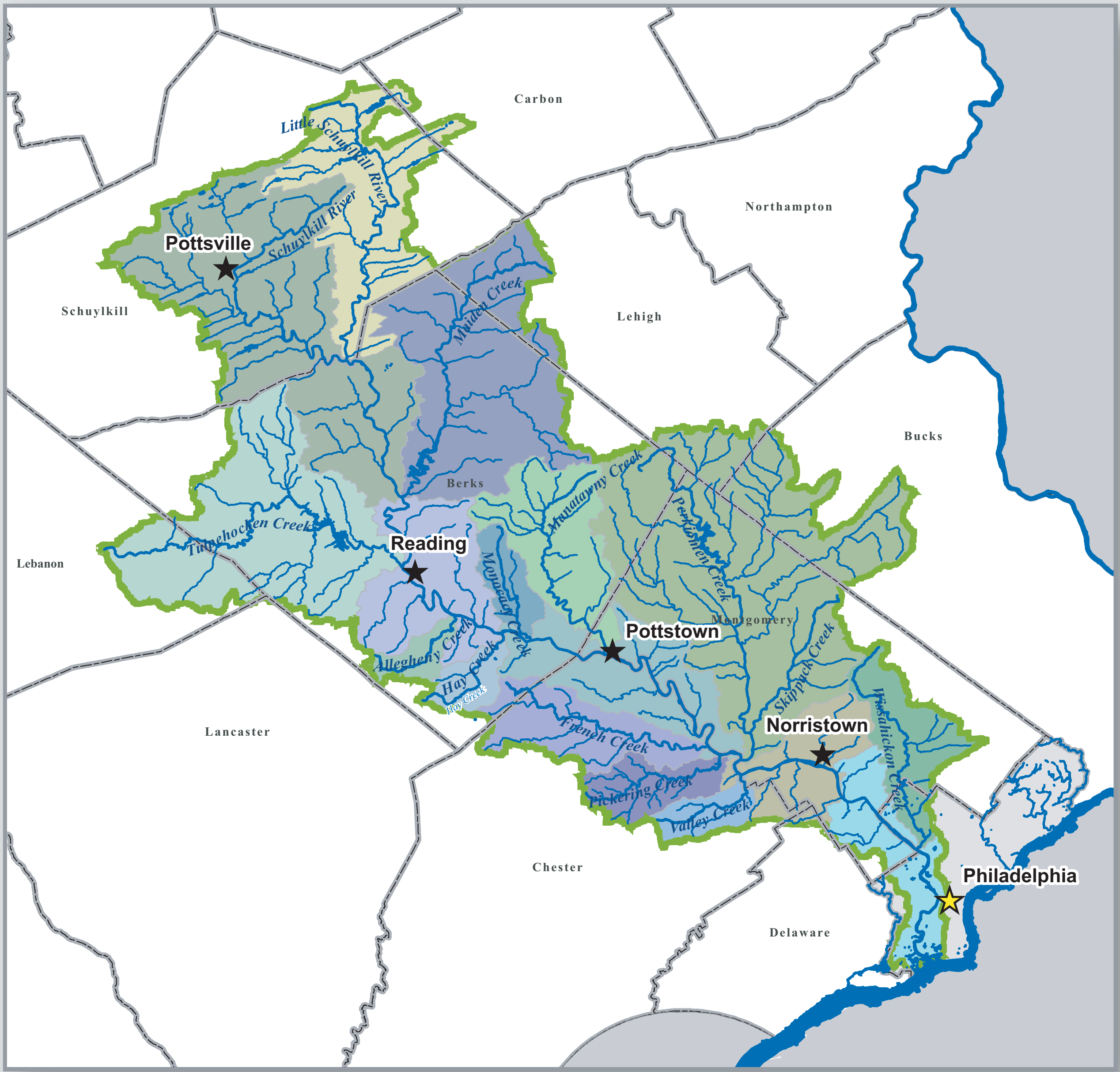
The Schuylkill River Watershed Source Water Protection Plan



Prepared by:

Philadelphia Water Department (PWSID #1510001)
Belmont & Queen Lane Surface Water Intakes

Philadelphia, Pennsylvania

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Schuylkill River Watershed Source Water Protection Plan
(PWD Belmont & Queen Lane Intakes – PWSID# 1510001)

The Schuylkill River Watershed Source Water Protection Plan is on file and available for public review at the following location:

Pennsylvania Department of Environmental Protection
Southeast Regional Office
2 East Main Street
Norristown, PA 19401

Any questions regarding the information contained within the protection plan should be directed to:

Christopher S. Crockett, Ph.D., P.E.
Manager – Watershed Protection
Philadelphia Water Department
Office of Watersheds
1101 Market Street, 4th Floor
Philadelphia, PA 19107
phone: (215) 685-6234
fax: (215) 685-6034
email: Chris.Crockett@phila.gov

- Executive Summary -
Schuylkill River Watershed Source Water Protection Plan
(PWD Belmont & Queen Lane Intakes – PWSID# 1510001)

Background & Overview

The Schuylkill River watershed is over 130 miles long, includes over 180 tributaries, and drains an area of 2,000 square miles. The watershed is located in southeastern Pennsylvania and is comprised of eleven counties and over three million residents. The headwaters of the Schuylkill River drain approximately 270 square miles of Schuylkill County and flow in a southeasterly direction into the tidal waters at the river's confluence with the Delaware Estuary. The basin includes large parts of Schuylkill, Berks, Montgomery, Chester, and Philadelphia counties and smaller parts of Carbon, Lehigh, Lebanon, Lancaster, Bucks, and Delaware counties. The major towns and cities along the river are Pottsville, Reading, Pottstown, Phoenixville, Norristown, Conshohocken, and Philadelphia. The Schuylkill River watershed is a source of drinking water for approximately 1.5 million people.

The Philadelphia Water Department (PWSID# 1510001) owns and operates two drinking water treatment plants at the bottom of the Schuylkill River watershed. PWD's Queen Lane intake is located 12 miles from the mouth of the Schuylkill River, directly downstream of the confluence of the Wissahickon Creek with the Schuylkill River. The Belmont intake is located at Schuylkill River mile ten, approximately two miles above Fairmount Dam.

PWD established a source water protection program in 1999 dedicated to protecting and improving its water supply. Between 1999 and 2003, PWD participated in the PADEP source water assessments as the primary contractor for surface water supplies in the Schuylkill River watershed. These assessments resulted in the identification of pollution sources posing the biggest threat to drinking water intakes along the Schuylkill. PWD used the results of this assessment to develop this comprehensive Source Water Protection Plan for the Belmont and Queen Lane intakes and the Schuylkill River watershed, which further prioritizes threats identified in the assessments and outlines several complementary approaches to reducing these threats.

This Source Water Protection Plan clearly identifies actual and potential sources of contamination to the raw water supplying PWD's water treatment plants and outlines targeted protection and cleanup projects to address these sources. The plan serves as the first step for long-term sustainable planning for the future of the communities in the watershed, and it provides a comprehensive framework for implementing a watershed-wide effort to improve source water quality. The plan incorporates the following seven objectives that will allow PWD to ensure the integrity and affordability of the region's water supply for generations to come.

1. Establish the Schuylkill Action Network as a permanent watershed-wide organization charged with identifying problems and prioritizing projects and funding sources to bring about real improvement in water quality throughout the Schuylkill River watershed.
2. Create a long-term, sustainable fund to support restoration, protection, and education projects in the Schuylkill River watershed.

3. Increase awareness of the Schuylkill River watershed's regional importance as a drinking water source.
4. Initiate changes in policies and decision-making that balance and integrate the priorities of both the Safe Drinking Water Act and Clean Water Act
5. Establish the Early Warning System as a regional information sharing resource and promote its capabilities for water quality monitoring and improving emergency communication.
6. Reduce point source impacts to water quality.
7. Reduce non-point source impacts to water quality.

Build Out Model

A land use/land cover build out scenario was developed and simulated using EPA's Stormwater Management Model to estimate potential changes in runoff pollutant loads throughout the watershed. The build out scenario was assembled using mostly available zoning data obtained on the county level. The scenario indicates the potential for a significant change in the land use/land cover within the Schuylkill watershed. Under current zoning, low density residential development could increase as agricultural and forested lands are developed. Specifically, the scenario predicts an increase in the percentage of high density residential development, because current zoning would allow this classification to more than triple. The area of commercial/industrial/transportation would more than double. These land use classifications typically have the greatest impact on watersheds since high impervious cover and pollution are associated with them. Under this build out scenario, the amount of impervious cover within the Schuylkill River watershed is estimated to increase by approximately 8% to a total of 18% impervious cover. An increase of this size would result in increased channel erosion, reduced water quality, and decreased stream diversity in the watershed.

Identification of Priority Protection Areas

Prioritization Methodology

During the source water assessment process, a susceptibility analysis was completed for each public water supply intake within the Schuylkill River watershed for the following ten parameters: chloride, *Cryptosporidium*, fecal coliform, metals, nitrates, petroleum hydrocarbons, phosphorus, total organic compounds (TOC), total suspended solids (TSS), and volatile organic compounds. The results can be found in the intake-specific reports generated during the source water assessments, which are available for public review at the PADEP regional offices. The sources were evaluated based on set criteria, which included relative impact of the source at the intake, impact of the source on treatment operation, potential health impacts, location of source, and the potential for release.

This protection plan builds on the results of the source water assessments. While the source water assessments established priority sources based on their impact on specific drinking water intakes, the protection plan re-examined these same sources and further prioritized them according to their impact on the watershed as a whole. The protection plan focuses only on those pollutants of primary concern as determined during the assessment process: *Cryptosporidium*, fecal coliform, nutrients, total organic carbon, and turbidity.

To determine the highest priority sources of contamination within the entire watershed, PWD used the intake-specific results from the susceptibility analysis for each of the priority pollutants listed above. PWD classified any source identified as a high, moderately-high, or moderate priority during the susceptibility analysis, to be potentially significant to an intake. PWD then reduced these sources to a final list of potentially high priority sources and updated the information available on the point sources using the PCS database. A new set of weighting criteria was then used to determine watershed priorities based upon contaminant load, the total amount of water withdrawn for drinking water purposes, and the total number of intakes within a five hour time of travel. For point sources, the total number of discharge monitoring report violations was also included in the weighting criteria.

Contamination from AMD, in the upper reaches of the watershed, and CSOs or SSOs, throughout the watershed, were not accounted for quantitatively in the prioritization analysis. It is recognized that these activities can be, and are, significant sources of contamination. Therefore, these sources are addressed through restoration and protection projects outlined in the plan.

Priority Sources

The following activities were identified as having a high priority for protection efforts to address:

- Sanitary sewer overflows of raw sewage from sewer collection systems, sewage lift stations, and manholes from upstream communities due to infiltration and inflow of stormwater into the sewer system or lack of wastewater treatment capacity;

- Combined sewer overflows from upstream communities such as Bridgeport and Norristown;

- Communities discharging untreated sewage without proper sewage treatment such as New Philadelphia;

- Urban and residential runoff from various areas of the watershed, mostly located along the mainstem of the Schuylkill River from Reading to Philadelphia, within the Wissahickon subwatershed, and the Lower Perkiomen subwatershed;

- Agricultural runoff in the Tulpehocken and Maiden Creek subwatersheds;

- Discharges from municipal and industrial sources such as sewage treatment plants and chemical manufacturing facilities along the mainstem of the Schuylkill River primarily between Philadelphia and Reading;

- Abandoned mine drainage from Schuylkill County;

- Spills and accidents from cars, tanker trucks, railroad cars, pipelines, tire piles, and fires at industrial facilities near the river and its tributaries.

Protection Projects

The prioritizations of potential sources completed within this protection plan allow PWD and their partners throughout the watershed to target specific areas in greatest need of restoration and protection efforts. The projects identified were developed based upon the results of the prioritization, the Little Schuylkill River and Upper Schuylkill River Assessment Reports prepared by L. Robert Kimball & Associates, PADEP's 303(d) stream assessment, and the project's location along a stream with a designated TMDL.

Due to the large size of the Schuylkill River watershed, stakeholders often find it difficult to successfully cut across regulatory, municipal, and jurisdictional boundaries to implement their projects and programs. However, the successful implementation of these projects is critical to the protection and integrity of the water supply. In recognition of this problem, EPA, PADEP, and PWD formed the Schuylkill Action Network in spring 2003. Members of the SAN, including government agencies, local watershed organization, and water suppliers, work in partnership to obtain funding, implement projects, and protect the water resources of the Schuylkill River watershed rather than competing with one another and duplicating efforts.

The SAN is comprised of various workgroups, which were developed to align with the major sources of contamination as identified during the assessment phase of the Schuylkill River. These sources include direct discharge, stormwater runoff, agriculture runoff, and abandoned mine drainage. The workgroups, which include representatives from local watershed organizations, municipal, state and federal government, water suppliers and non-profit organizations, are charged with working collaboratively to prioritize, secure funding for, coordinate, and implement restoration projects that address their areas of responsibility and expertise.

In June 2004 the SAN was awarded $1,149,340 through EPA's Targeted Watersheds Initiative Program for the implementation and construction of "demonstration projects" throughout the Schuylkill River watershed. The grant will be managed by the Partnership for the Delaware Estuary and is expected to act as "seed money" for the SAN to launch the group's various initiatives. The SAN is also looking to develop a business plan for a long term sustainable funding source dedicated to restoration and protection of the Schuylkill River watershed.

The SAN member organization responsible for implementing the project or program is based upon several factors including the type of project, the size and cost of the project, and the organization's ability to spend funding on a project outside of jurisdictional boundaries. The organization's overall mission is also a factor when determining who will implement and fund the various projects.

While PWD is one of the founding members of the SAN and participates heavily in the various workgroup activities and in providing technical guidance, PWD does have a responsibility to protect the water quality for its 1.1 million customers supplied with water from the Schuylkill River watershed; specifically the water quality of the Wissahickon and Lower Schuylkill subwatersheds as they are the direct source of withdrawal for the PWD-Belmont and Queen Lane intakes. In response to this charge, PWD will attempt to implement over 20 projects and initiatives during the next five years which are expected to show cumulative improvements in water quality in the Wissahickon and Lower Schuylkill subwatersheds. These projects are all located within the 25-hour time of travel of the Belmont and Queen Lane intakes. PWD will continue its participation in the SAN by providing technical guidance to the various workgroups and supporting the SAN's projects and initiatives.

The following tables list projects and initiatives currently planned or already underway through the direction of PWD and the SAN. In addition to these proactive protection measures, PWD also has the Delaware Valley Early Warning System and PWD's Response Plans in place to address emergency spills, accidents, and deliberate contamination to the water supply. These projects will help PWD and our partners to not only improve our water quality, but will also help meet the requirements and balance the priorities of the Safe Drinking Water Act and Clean Water Act, creating a "fishable", "swimmable", and "drinkable" Schuylkill River.

Table 1 - SAN Protection Projects and Initiatives

Project Name	Description	Project Partners
Abandoned Mine Drainage		
Pine Forest	Anoxic limestone drain and aerobic wetland treatment system	Schuylkill Headwaters Association, Schuylkill County Conservation District
Pine Knot	Treatment system for largest AMD discharge in the watershed	
Reevesdale South Dip Tunnel	Oxic limestone drain and aerobic wetland treatment system	
Oakhill Boreholes & Silverbrook Mine	Treatment feasibility studies	
Stormwater		
Brookside Country Club	Dam removal and streambank restoration	PWD, RiverKeeper
Lansdale Borough	Outfall infiltration	Borough of Lansdale, Wissahickon Valley Watershed Association
Norristown High School	Construction of bioretention areas to infiltrate parking lot runoff	Norristown School District, Stony Creek Anglers
Wissahickon Detention Basin Study	Feasibility study of detention basin retrofits in the Wissahickon subwatershed	PWD, Wissahickon Valley Watershed Association
Wastewater Dischargers/Compliance		
Act 537 Planning	Workshop to encourage implementation of 537 plans	EPA, municipalities
Case Study for Nutrient Trading	Study to identify opportunities for nutrient trading in the Wissahickon subwatershed	EPA, PADEP, PWD
Sewage Facilities Self-Assessment Program	Self evaluation program of sewage facility operations	EPA, municipalities
Agriculture		
Parcel Prioritization	Identify contiguous farms for streambank fencing projects based upon location along an impaired stream reach	Berks County Conservation District, United States Department of Agriculture, farming community, Berks County Conservancy
Education/Outreach		
Golf Course Certification	Stormwater management certification for golf course managers	PWD, Audubon International
School Certification & Awards	Establish stormwater management certification program for schools	Partnership for the Delaware Estuary
Schuylkill Watershed Signage	Install watershed signage (billboards & signs) along major highways	Partnership for the Delaware Estuary, PADEP
Environmental Advisory Councils (EACs)	Creation of EACs in high priority protection areas	Pennsylvania Environmental Council, municipalities, League of Women Voters
Perkiomen Subshed Outreach Pilot	Education and outreach support of Perkiomen Watershed Conservancy-Subwatershed Initiative demonstration	Perkiomen Watershed Conservancy, Aqua America

Table 2 - PWD Protection Projects and Initiatives

Project Name	Description
Bacteria Source Tracking Study	"Bacteria library" with a focus on *Cryptosporidium*
Bells Mill Run and Gorgas Lane Plunge Pool	Redesign of plunge pool area and tributary downstream
Belmont Intake Phase II Meadow Extension	Fencing and native planting to decrease geese activity near PWD intake
Carpenter's Woods	Design for two stream channels and stormwater wetland construction
Courtesy Stables Runoff Treatment Project	Stormwater routing into grassed filter strip; educational signage
Dobson's Run Elimination	Sewer Control – removal of two intercepting chambers
Early Warning System Reporting Initiative	Developing process/procedure for PADEP Regional Emergency Response personnel to utilize EWS notification for appropriate incidents/events
Environmental Advisory Committee Initiative	Creation of EACs in high priority areas
Erdenheim Farms	Acquisition of a permanent riparian buffer on an active farm
Erosion and Sedimentation Inspector	Hire E&S inspector to monitor City construction projects
General *Cryptosporidium*/Viability Study	Assess the impacts of UV at waste water treatment plants on *Cryptosporidium*
Livezy Dam Removal	Removal of dam to decrease detrimental water quality impacts from "ponding"
Main & Shurs Elimination	Sewer Control – removal of relief overflow
Manayunk Canal Aeration Project	Surface aeration to increase dissolved oxygen levels
Monestary Stables Stormwater & Detention Project	Construction of stormwater management controls
On-Line Monitoring at Water Treatment Plant Intakes	Expansion of real-time monitoring network
Philly RiverCast	Web based tool to forecast water quality that predicts potential levels of pathogens in the Schuylkill River between Flat Rock Dam and Fairmount Dam
Saylor Grove Stormwater Wetland	Construction of a 1-acre stormwater wetland in the Wissahickon Watershed
Stormwater Regulations Development	revise and adopt current ordinance and add redevelopment component
Technical Assistance for Schools	technical assistance for two conceptual designs for BMPs
W.B. Saul High School Project	Cattle crossings, cattle fencing, riparian buffer construction
Watershed Information Center	Web based regional resource of Southeastern Pennsylvania watershed-related information
Waterways Restoration Team	Monitor activity near streams, remove debris and implement small restoration efforts
Wissahickon Feasibility Study	Evaluate options for stream restoration, dam removal, wetland creation and other potential means for improving water quality and addresses water quantity in the Wissahickon Creek
Wissahickon/Monoshone Defective Laterals Program	Identification of defection laterals and loan program for financial assistance with remediation

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Section 1. Overview of the Source Water Program and Protection Plan

1.1 Introduction

The Philadelphia Water Department (PWD) has long recognized the importance of water supply protection dating back to the 1880's, when the City of Philadelphia created what is known today as Fairmount Park. In order to protect the city's water supply from pathogens that caused typhoid and cholera, the city purchased lands adjacent to the Schuylkill River and its tributaries. Since that time the watershed has changed significantly. Industrialization and development upstream of the city brought the need to build wastewater treatment plants along the Schuylkill River. Emergence of pathogens such as *Cryptosporidium* and other contaminants that could pass through existing surface water treatment processes have demanded ever more sophisticated levels of technology. Current threats also require a renewed focus on source water protection in order to maximize the quality of PWD's water supply.

In response to this need, PWD established a source water protection program in 1999 dedicated to protecting and improving its water supply. Between 1999 and 2003, PWD participated in the Pennsylvania Department of Environmental Protection (PADEP) source water assessments as the primary contractor for surface water supplies in the Schuylkill River watershed.[1] PWD held over 25 technical advisory group and public meetings with watershed stakeholders to obtain information on which potential sources were of the greatest importance to them. These assessments resulted in the identification of pollution sources posing the biggest threat to drinking water intakes along the Schuylkill. PWD then used the results of this assessment to develop this comprehensive source water protection plan for the Belmont and Queen Lane intakes and the Schuylkill River watershed, which further prioritizes threats identified in the assessments and outlines several complementary approaches to reducing these threats.

Due to the large size of the Schuylkill River watershed, it can be difficult to successfully implement projects that cover such a wide range in scope and effectively address the problems associated with the watershed. In response to this issue, the U.S. Environmental Protection Agency (EPA), Delaware River Basin Commission (DRBC), PADEP, and PWD formed the Schuylkill Action Network (SAN) in spring 2003. Members of the SAN include regulatory agencies, municipal governments, local watershed organizations, water suppliers, and conservation districts. These organizations work in partnership to transcend jurisdictional boundaries and obtain funding to improve the water resources of the Schuylkill River watershed. Often times, the various organizations within the watershed all share the same goal of improving the water quality of the Schuylkill River. By building upon these existing partnerships, rather than competing for resources and duplicating efforts, greater successes can be made.

[1] PWD was the recipient of the 2002 USEPA Region III Source Water Protection Award, the 2003 Exemplary Source Water Protection Award by the American Water Works Association, and the 2003 USEPA Clean Water Partners Award

This source water protection plan fills several specific roles. It clearly identifies actual and potential sources of contamination to the raw water supplying PWD's water treatment plants and outlines targeted protection and cleanup projects based on these sources. Secondly, information from the plan can be utilized by members of the SAN to effectively educate the public about its drinking water source and efforts being made to protect and improve it. Thirdly, the plan serves as the first step for long-term sustainable planning for the future of the communities in the watershed. Lastly, it provides a comprehensive framework for implementing a watershed-wide effort to improve source water quality.

1.2 Background on Source Water Assessments

The Schuylkill River is a source of drinking water for over 1.5 million people. At 130-miles in length with over 180 tributaries, the Schuylkill drains an area of 2,000 square miles of southeastern Pennsylvania and is the largest tributary to the Delaware Estuary. The watershed is diverse, flowing from the Appalachian Mountains, through rich farmland and low rolling hills, into the highly urbanized Atlantic Coastal Plain.

Industrialization and mining in the 19th and 20th centuries left the Schuylkill as one of the most polluted rivers in the nation. In recent years, the river's water quality has improved and migratory fish are returning, but problems remain. Major contributors to these problems include stormwater runoff, agricultural practices, abandoned mine drainage, and sewage overflows.

Between 1999 and 2003, the Schuylkill River Source Water Assessment Partnership, comprised of PADEP, PWD, the Pennsylvania Suburban Water Company[2], the Pennsylvania American Water Company, county planning commissions, watershed organizations, and interested citizens, conducted an assessment of 42 drinking water intakes to identify water supply protection priorities in the Schuylkill River watershed. The assessment process contained several unique aspects, including:

- The development of a comprehensive, point source database for the entire Schuylkill River watershed. The database is programmed to locate the thousands of potential point sources in relationship to the river and tributary, estimate potential contaminant loading for 10 contaminant categories from each source, estimate potential contaminant concentration at the intake from each of the sources, and estimate travel time to the intake under high water flow conditions from each of the sources.

- The development of one of the largest applications of a stormwater model using the EPA SWMM code to estimate non-point source contaminant loading to the Schuylkill River for nine of the 10 contaminant categories. The SWMM model is a continuous simulation model.

- The use of sophisticated decision support software to screen the thousands of point sources, and to integrate the point sources and non-point sources into a single evaluation to identify the 100 highest priority sources for each of the 42 intakes in the watershed.

[2] Philadelphia Suburban Water Company was purchased in 2003 by Aqua America, Inc.

The assessment process outlined above resulted in a comprehensive list of contaminant sources and priority restoration locations. Detailed information on the assessment process can be found in Sections 1.5, 2.2.2, 2.2.3, and 2.2.4 of the source water assessment reports available for public review at the PADEP regional offices.

1.3 Key Findings of the Source Water Assessments

Although over 3,000 potential point sources were identified within the Schuylkill River watershed, most of these potential sources do not and will never discharge into the Schuylkill River. The highest concentrations of potential point sources are located in the most highly developed subwatersheds, the Middle and Lower Schuylkill subwatersheds. Sewer systems, dry cleaners, and machine/metal related industries were the most frequently identified potential point sources throughout the watershed. Monocacy Creek, Wissahickon Creek, and Valley Creek had the greatest number of dischargers per acre of drainage area. Based upon drainage area and flow, the Wissahickon Creek had the highest discharger density.

Of the non-point sources identified during the assessment phase, the developed land areas associated with industrial/commercial land use and residential uses are estimated to contribute the highest per-acre loadings of most of the contaminants evaluated, including disinfection by-products, metals, nutrients, petroleum hydrocarbons, salts, and coliforms.

Below is a summary of pollution sources identified as threats specific to PWD's Belmont and Queen Lane intakes during the source water assessments, primary locations of those sources, and contaminants associated with them. Detailed findings from the assessments can be found in Section 2.2.4 of the PWD SWAP report.

Table 1.3-1 Priority Sources at the PWD Belmont and Queen Lane Intakes

Source	Protection Priority	Description	Priority Area(s)	Contaminants
Treated Sewage	A – C (Moderate – High)	Wastewater discharges from wastewater treatment plants	Reading to Philadelphia	Pathogens, viruses, *Cryptosporidium*, nutrients, organic chemicals
Untreated Sewage	A (High)	Combined sewer overflows	Bridgeport, Norristown, & Schuylkill County	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients
Urban/Residential Runoff	A – C (Moderate – High)(	Stormwater runoff from roads, parking lots, roofs	Reading to Philadelphia	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients, metals, sediment
Agricultural Runoff	A – C (Moderate – High)	Stormwater runoff from croplands, pastures, livestock	Perkiomen Creek & Tulpehocken Creek	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients, sediment
Abandoned Mine Drainage	C (Moderate)	Discharge from abandoned coal mining areas	Schuylkill County	Metals
Industrial Facilities	A-C (Moderate)	Facilities that store or use hazardous chemicals	Reading to Philadelphia	Metals, nutrients, organic chemicals
Above Ground Storage Tanks	A-C (Moderate)	If storage tank spilled into river	Reading to Philadelphia	Petroleum hydrocarbons, metals, phosphorus
Landfills	C (Moderate)	Leaching of contaminants into streams	Reading to Philadelphia	Petroleum hydrocarbons, metals
Spills and Accidents	A – C (Moderate – High)	Car, truck, train, or pipeline accident spilling benzene	watershed-wide	Petroleum hydrocarbons, organic chemicals

Note: *Petroleum hydrocarbons include chemicals found in oils and greases*
Organic chemicals include chemicals found in solvents, degreasers, varnishes, paints, gasoline, plastics, insect and weed killers.
Rankings: *A – highest protection priority, B- moderately high protection priority, C-moderate protection priority, D through F low protection priorities.*

1.4 Relating the Source Water Assessments to the Protection Plan

This protection plan builds on the results of the source water assessments. For example, the source water assessments established priority sources based on their impact on specific drinking water intakes. The protection plan re-examined these same sources and further prioritized them according to their impact on the watershed as a whole. Also, the source water assessment examined pollution sources based on a set of ten contaminants determined by PADEP's guidelines for conducting watershed assessments. The protection plan further refines the results of the assessment by focusing only on those pollutants of primary concern as determined during the assessment process: *Cryptosporidium*, fecal coliform, nutrients, total organic carbon, and turbidity.

According to the Little Schuylkill River and Upper Schuylkill River Assessment Reports prepared by L. Robert Kimball & Associates in 2001, metals are also a priority in the middle and upper Schuylkill River watershed. The source of metals can be directly linked to abandoned mine discharges at specific sites within the upper reaches of the watershed. While metals are addressed through various restoration and protection projects outlined in this source water protection plan, a new prioritization for metals was not conducted.

Results of the watershed-wide prioritizations performed in putting together the protection plan are summarized below. Detailed findings can be found in Section 3.1.3 of this document. Detailed prioritization methodologies implemented during both the intake-specific and watershed-wide prioritizations, including specific criteria used, can be found in Section 3.1.2 of this protection plan.

Table 1.4-1 Priority Sources in the Schuylkill River Watershed

Source	Description	Priority Area(s)	Contaminants
Treated Sewage	Wastewater discharges from wastewater treatment plants	Reading to Philadelphia	Pathogens, viruses, *Cryptosporidium*, nutrients, organic chemicals
Untreated Sewage	Combined sewer overflows	Bridgeport, Norristown, & Schuylkill County	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients
Urban/Residential Runoff	Stormwater runoff from roads, parking lots, roofs	Reading to Philadelphia	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients, metals, sediment
Agricultural Runoff	Stormwater runoff from croplands, pastures, livestock	Perkiomen Creek , Tulpehocken Creek, Maiden Creek	Pathogens, bacteria, viruses, *Cryptosporidium*, nutrients, sediment
Abandoned Mine Drainage	Discharge from abandoned coal mining areas	Schuylkill County	Metals
Spills and Accidents	Car, truck, train, or pipeline accident spilling benzene	Watershed-wide	Petroleum hydrocarbons, organic chemicals

1.5 Other Data Informing the Protection Plan

This protection plan outlines specific projects intended to address sources of pollution and to improve the quality of the PWD's water supply. (Please refer to Section 3.4 for a complete project list.) These projects are largely determined by the watershed-wide source prioritizations, although additional data were considered in determining the specific actions selected. PADEP's 305b Water Quality Assessment Report of 2003, for example, identifies impaired stream segments in the Schuylkill River based on biological and chemical data collected throughout the watershed. According to PADEP's report, stormwater is the primary cause of impairment in the Schuylkill River watershed, with a total of 273 stormwater impaired stream miles. The majority of these impairments are located within Montgomery and Philadelphia Counties, the watershed's most populous counties. Agriculture is the second leading cause of impairment in the watershed, with 258 agriculturally impaired stream miles. Over 160 impaired miles are located within Berks County, the state's fifth leading county in agricultural production. Abandoned Mine Drainage (AMD) is the third leading cause of impairment within the entire watershed, and the leading cause of impairment in the headwaters. There are a total of 222 AMD impaired stream miles within the watershed.

By putting forth projects intended to address concerns and priorities from multiple sources, this protection plan ensures a comprehensive approach to improving the Schuylkill River as a drinking water source as outlined by the Safe Drinking Water Act Reauthorization of 1996 (SDWA). Additional components of the SDWA include the adoption of a watershed protection program, public involvement in setting water system priorities, and the establishment of drinking water protection, all of which are incorporated either through PWD's existing Source Water Program, within this protection plan, or through PWD's involvement with the SAN.

1.6 Implementing Projects Outlined in the Protection Plan

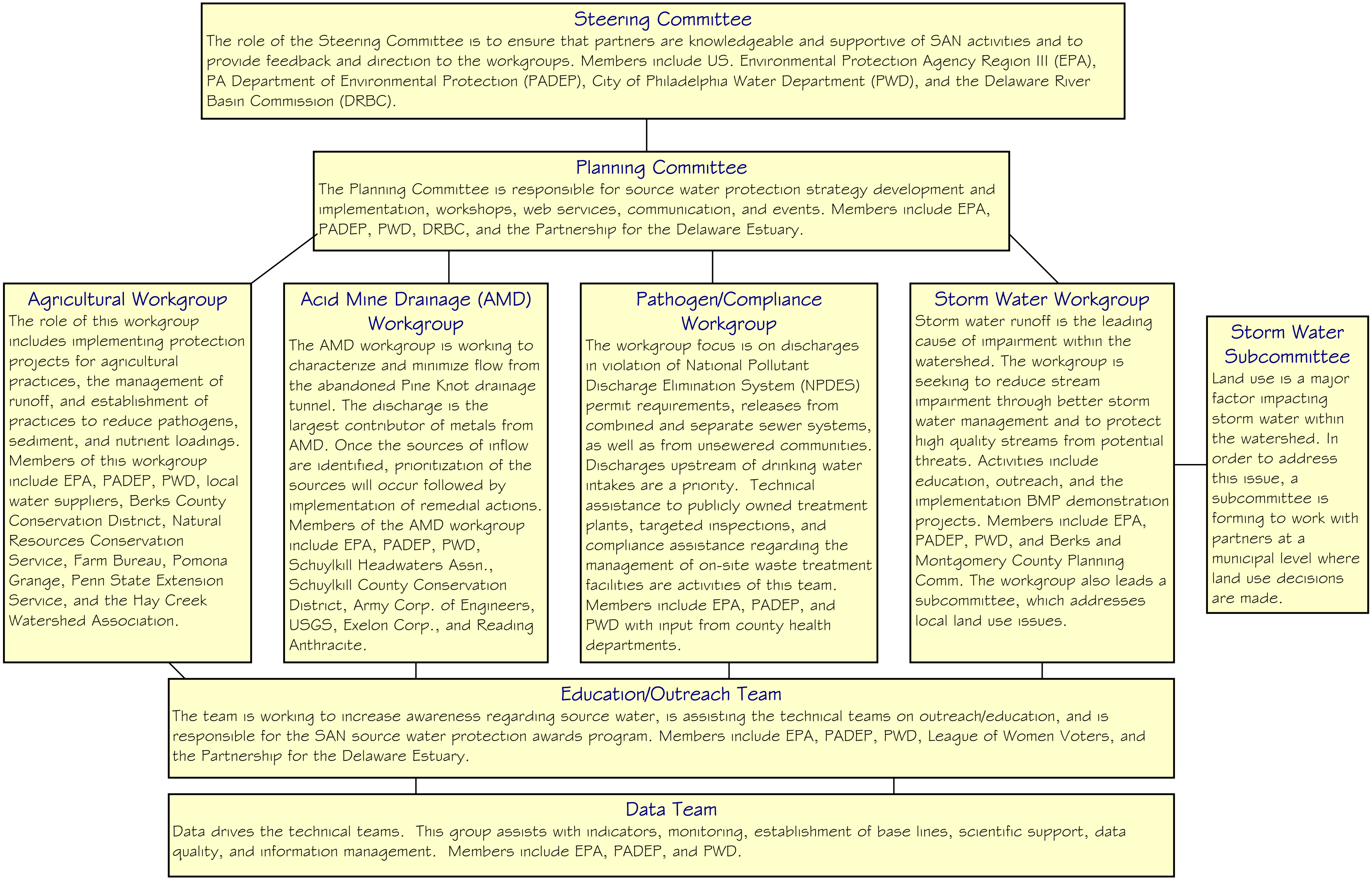
PWD's approach for successful implementation of its protection plan is two-fold. First, PWD is committed to directly carrying out those projects that specifically relate to the water quality of the Wissahickon and Lower Schuylkill subwatersheds, as they are the direct source of withdrawal for the PWD Belmont and Queen Lane intakes. Second, PWD is committed to helping ensure the success of the SAN in their whole-watershed restoration approach. The SAN's mission is to transcend regulatory and jurisdictional boundaries in protecting the Schuylkill River, positioning the SAN to be integral to implementing key elements of this protection plan.

At the core of the SAN are its workgroups, which were developed to align with the major sources of the major contaminants identified during the assessment phase of the Schuylkill River. These sources include direct discharge, stormwater runoff, agriculture runoff, and AMD. The workgroups, which are comprised of representatives from local watershed organizations, municipal, state and federal government, water suppliers and non-profit organizations, are charged with working collaboratively to prioritize, secure funding for, coordinate, and implement restoration projects that address their areas of responsibility.

The SAN also includes a support system for the workgroups. The Data Team is responsible for the SAN's website and for creating a data warehouse through which information can easily be shared among workgroup participants and other watershed stakeholders. The Education Team assists the workgroups in educating residents, students, municipal officials and other decision-makers of the threats to the Schuylkill River as a drinking water source, as well as actions they can take to reduce those threats. The Executive Steering Committee provides high level feedback and direction to the SAN action workgroups and teams. Finally, the Planning Committee helps inform Executive Steering Committee decisions, helps secure funding for workgroup projects, and performs administrative SAN duties. Figure 1.6-1 shows the organizational framework of the SAN.

In July 2004 the SAN was awarded $1,149,340 through EPA's Targeted Watersheds Initiative Program. The funding will be used by the SAN to launch the group's various initiatives and to promote the recommendations and implementation projects outlined in this protection plan. The SAN is also looking to develop a business plan for a long term sustainable funding source dedicated to restoration and protection of the Schuylkill River watershed.

Figure 1.6-1 Organization Framework of SAN



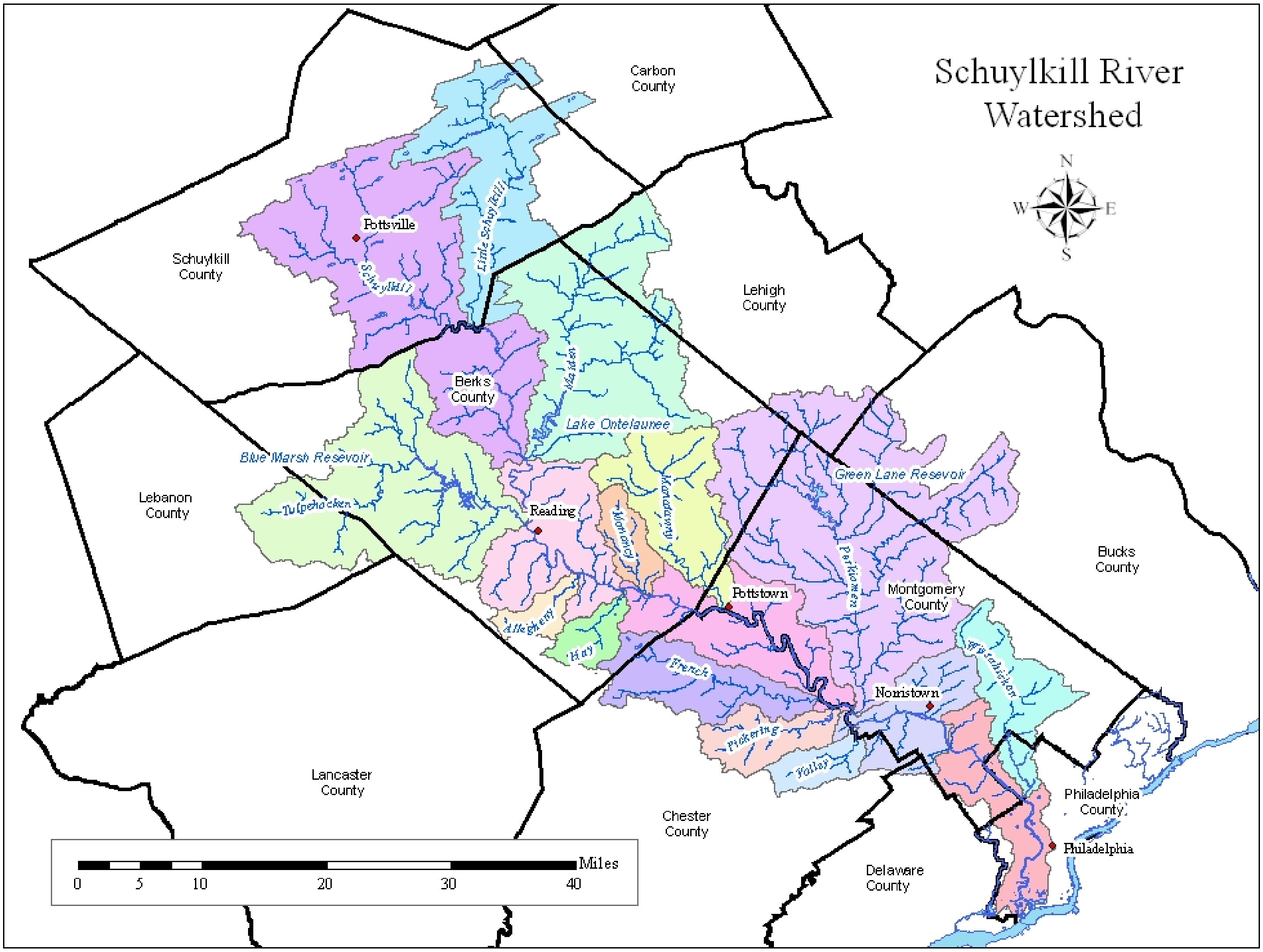
Section 2. Watershed Description

2.1 Watershed & Surface Water Intakes

2.1.1 General Overview

The Schuylkill River watershed is over 130 miles long, includes over 180 tributaries, and drains an area of 2,000 square miles. The watershed is located in southeastern Pennsylvania and is comprised of eleven counties and over three million residents. The headwaters of the Schuylkill River drain approximately 270 square miles of Schuylkill County and flow in a southeasterly direction into the tidal waters at the river's confluence with the Delaware Estuary. The basin includes large parts of Schuylkill, Berks, Montgomery, Chester, and Philadelphia counties and smaller parts of Carbon, Lehigh, Lebanon, Lancaster, Bucks, and Delaware counties. The major towns and cities along the river are Pottsville, Reading, Pottstown, Phoenixville, Norristown, Conshohocken, and Philadelphia. The Schuylkill River watershed is a source of drinking water for approximately 1.5 million people.

Figure 2.1.1-1 Schuylkill River Drainage Basin



2.1.2 Geology and Soils

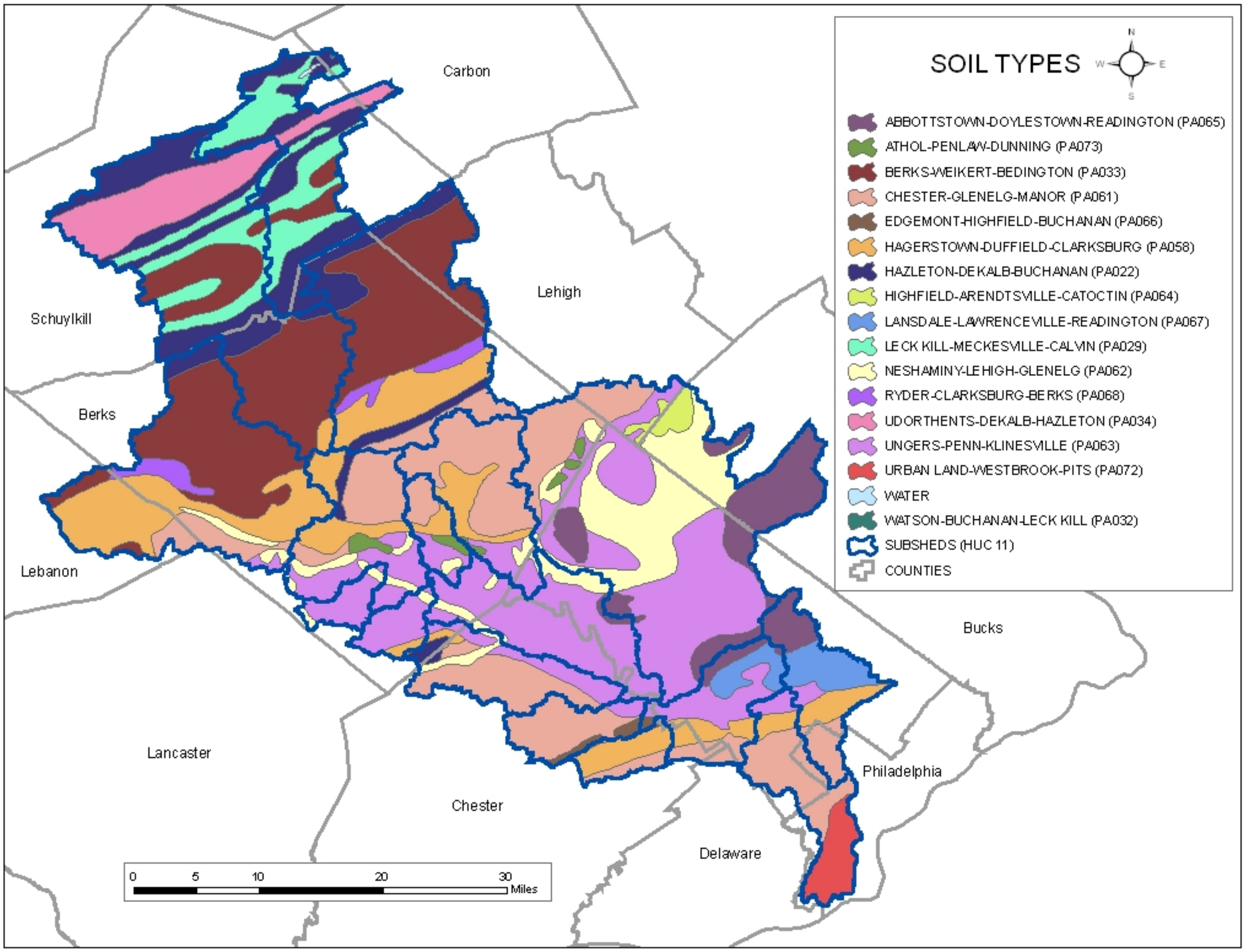
The physical properties of the soils are the determining factor in the sediment-transport characteristics of the Schuylkill River and its tributaries. The soils, in turn, are determined by the geology and weathering processes of the rock material. Within the major hydrological classifications and groups of soils, there are 16 specific subtypes in the Schuylkill River watershed. As shown in Figure 2.1.2-1, these soil subtypes vary with location in the watershed, but mainly two or three types dominate within a given subwatershed. In some cases, large portions of the watershed are one soil type. The Abbottstown, Chester, Hagerstown, Neshaminy, and Ungers soil classifications define approximately 90 percent of the watershed soils. As shown in Table 2.1.2-1, these soils are generally well drained, generate moderate runoff during rain events, and are located on significant slopes. The only poorly drained soil, the Abbottstown soil, is located in the headwaters areas of the Wissahickon and Perkiomen Creek subwatersheds.

Table 2.1.2-1 Prevalence of Various Soil Types in the Schuylkill River Watershed

Soil Type	Percentage of Watershed	Slopes %	Permeability	Runoff	Drainage	Found on
Abbottstown-Doylestown-Readington (PA065)	13	0-15	Slow to moderate	Slow to medium	Poorly drained	Level to sloping concave upland flats, depressions and drainage ways
Athol-Penlaw-Dunning (PA073)	0	0-35	Moderate	Slow to rapid	Well drained	Level to moderately steep convex and dissected upland ridge tops and side slopes
Berks-Weikert-Bedington (PA033)	18	0-90	Moderately Rapid	Medium to rapid	Well drained	Rounded uplands and gently sloping to very steep areas on uplands
Chester-Glenelg-Manor (PA061)	19	0-65 (mostly 3-10)	Moderate	Medium	Well drained	Upland divides and slopes
Edgemont-Highfield-Buchanan (PA066)	1	0-70	Moderate to moderately rapid	Rapid	Well drained	Sloping hills and ridges
Hagerstown-Duffield-Clarksburg (PA058)	6	0-45 (mostly 15)	Moderate	Moderate to rapid	Well drained	Valley floors and adjacent hills
Lansdale-Lawrenceville-Readington (PA067)	5	0-25	Moderate to moderately rapid	Moderate	Well drained	Rolling uplands
Neshaminy-Lehigh-Glenelg (PA062)	15	1 to 45	Moderately slow	Slow to very rapid	Well drained	Level to steep uplands
Ungers-Penn-Klinesville (PA063)	36	0-50	Moderate or moderately rapid	Medium to rapid	Well drained	Gently sloping to steep slopes

Note: Data from NRCS Official Soil Classifications and PASDA soil

Figure 2.1.2-1 General Distributions of Soils and Parent Rocks in the Schuylkill River Watershed

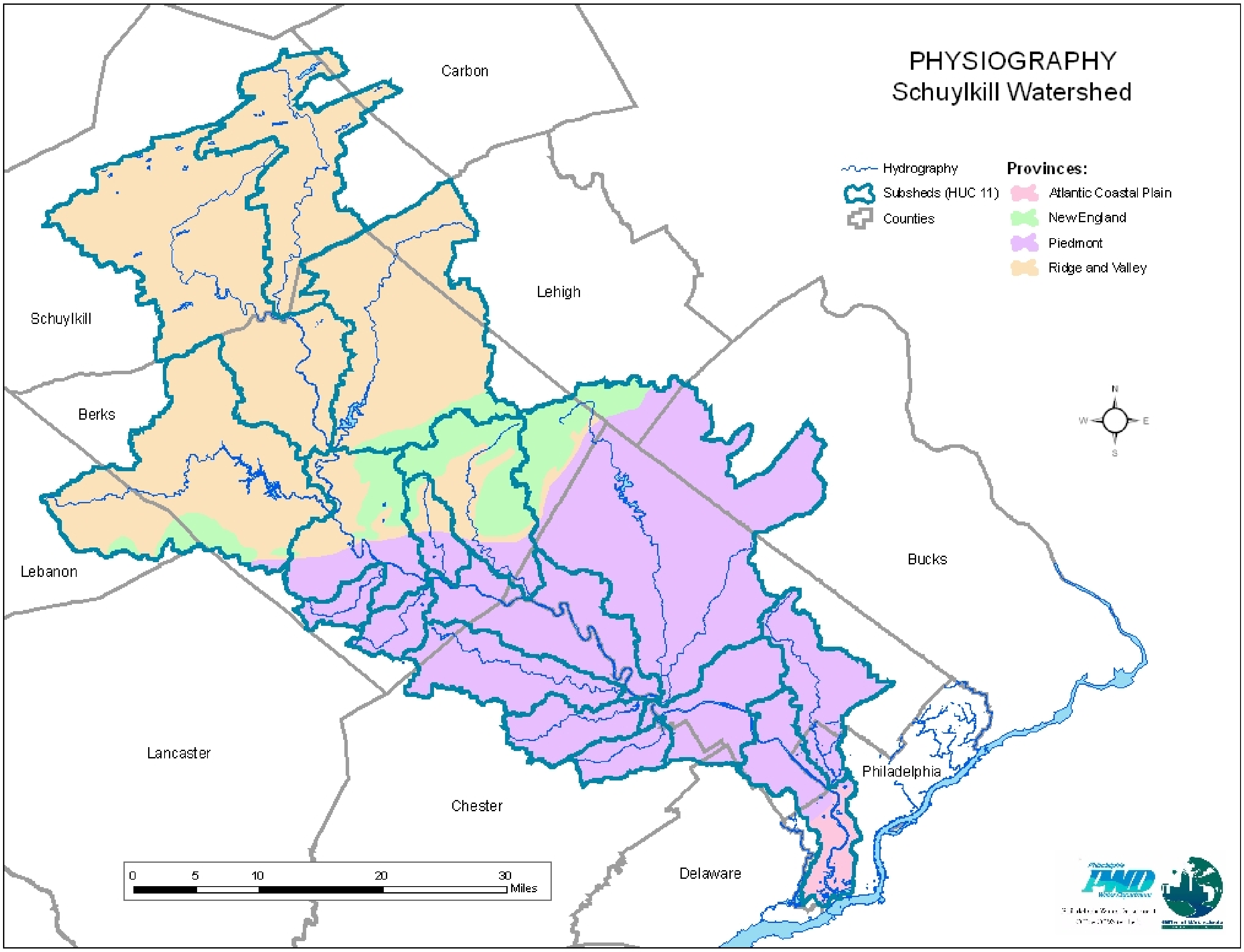


2.1.3 Physiography

The Schuylkill River Basin is characterized by many diverse landforms and various physiographic provinces in southeastern Pennsylvania. It includes 12 major subwatershed systems. The river has its origins in Schuylkill County in the Appalachian Mountains, and it drains over 1,900 square miles between the mountains and its confluence with the Delaware River at Philadelphia.

The Schuylkill River flows through four physiographic provinces. From upstream to downstream, they are the Valley and Ridge, New England, Piedmont and Atlantic Coastal Plain as shown on Figure 2.1.3-1. The Valley and Ridge Province is comprised of the mountains in the Appalachian Mountain section and rolling farmlands in the Great Valley. Elevations in the Valley and Ridge Province reach up to 1,800 feet above mean sea level (msl). The Appalachian Mountain section of the watershed is comprised of the Blue Mountain Province, a long narrow mountain ridge separated by narrow and wide valleys. The Blue Mountain Province rises more than 1,200 feet above msl. The Great Valley lies south of Blue Mountain and consists of broad lowlands. The New England Province includes the Reading Prong, which is composed of the small mountains east of Reading. The Triassic Lowland of the Piedmont Province is characterized by rich farmland and low rolling hills, whereas the Piedmont Uplands include steep hills with urban development. The rolling hills of the Piedmont Province reach about 500 feet above msl. The Atlantic Coastal Plain Province is mainly lowlands with numerous streams and marshlands at about 100 feet above msl.

Figure 2.1.3-1 Physiographic Provinces of the Lower Schuylkill River Watershed



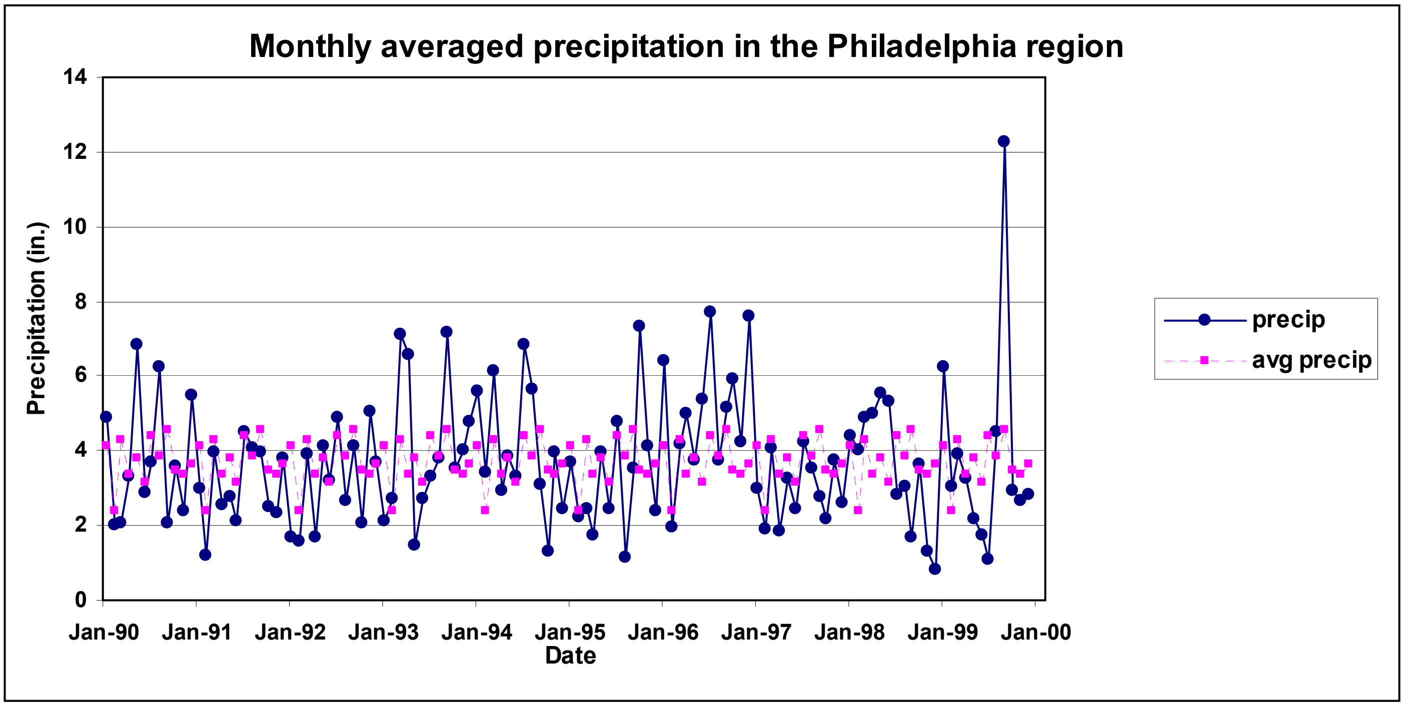
2.1.4 Hydrology

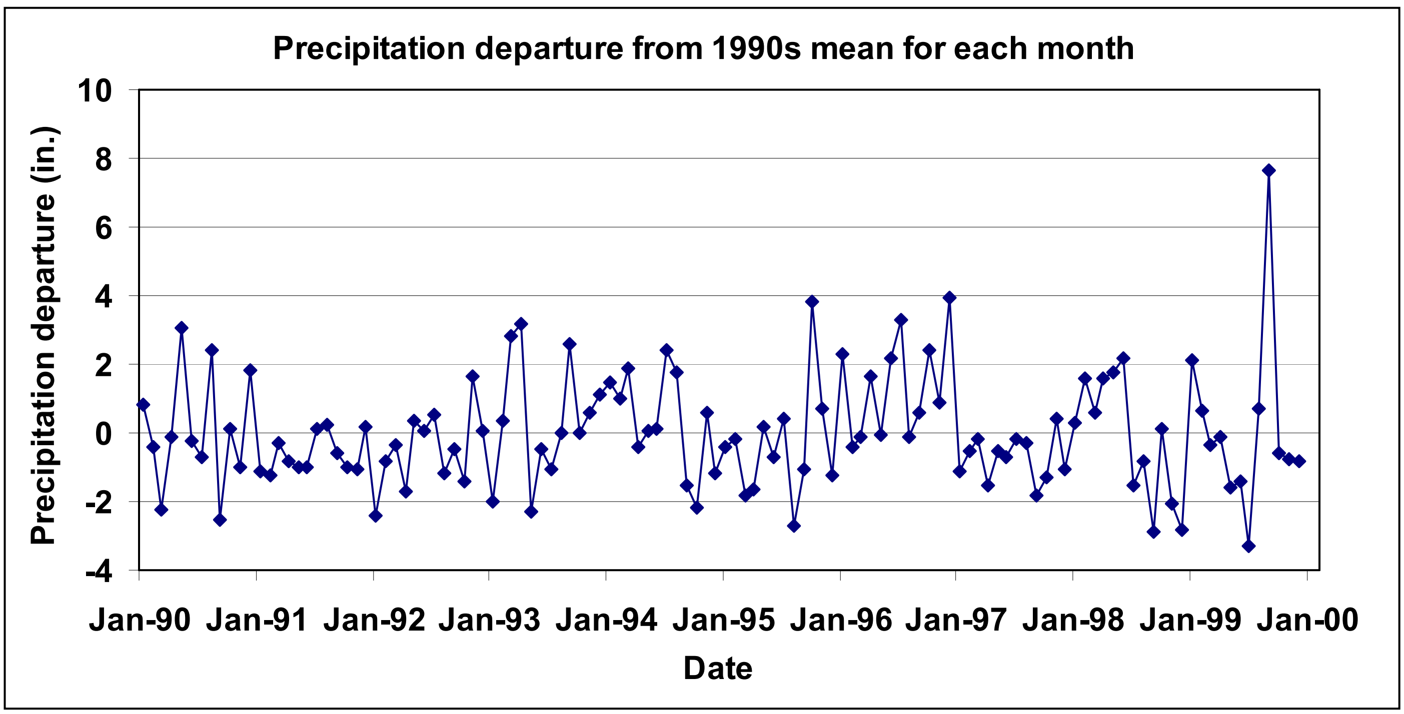
The Schuylkill River Basin has a humid climate with a wide range of both daily and annual temperatures. The physiographic features have a great effect upon the weather and climate of various areas within the basin. The local temperature within the watershed at a given time is dependent on ground elevation and latitude. Greater temperature and precipitation variations are experienced in the Appalachian Mountain physiographic sections than in the Coastal Plain and Piedmont areas.

Long-term historical data were initially assessed in order to gauge recent decade scale trends against the backdrop of natural regional variation in climate and hydrology. Monthly climate data based on a regional composite index developed by the National Climatic Data Center (NCDC) are available from 1895 through present day. Historical climate data has been further summarized here by calculating annual totals for precipitation and monthly averages for temperature. The mean annual temperature in the watershed is 52°F; the winter and summer averages are 31°F and 72°F, respectively (Biesecker et al., 1968). Average annual precipitation ranges from 43 inches per year in the Coastal Plain area to 45 to 50 inches per year in the Appalachian Mountains.

As shown in Figures 2.1.4-1 annual precipitation in the Philadelphia area has shown a steady increase through the 1900s, with an extended period of drought in the 1960s. Precipitation was high in the 1970s and has most recently varied around the long-term mean for annual precipitation. The small pink squares in the top figures of Figure 2.1.4-1 indicate the monthly precipitation averages during the 1990s. Deviation from the monthly averages, shown in blue, indicates interannual trends toward particularly wet or dry weather. Averages are calculated by calendar month, so deviation in January, for instance, is the difference between the 1990's average January precipitation and that occurring in a given year.

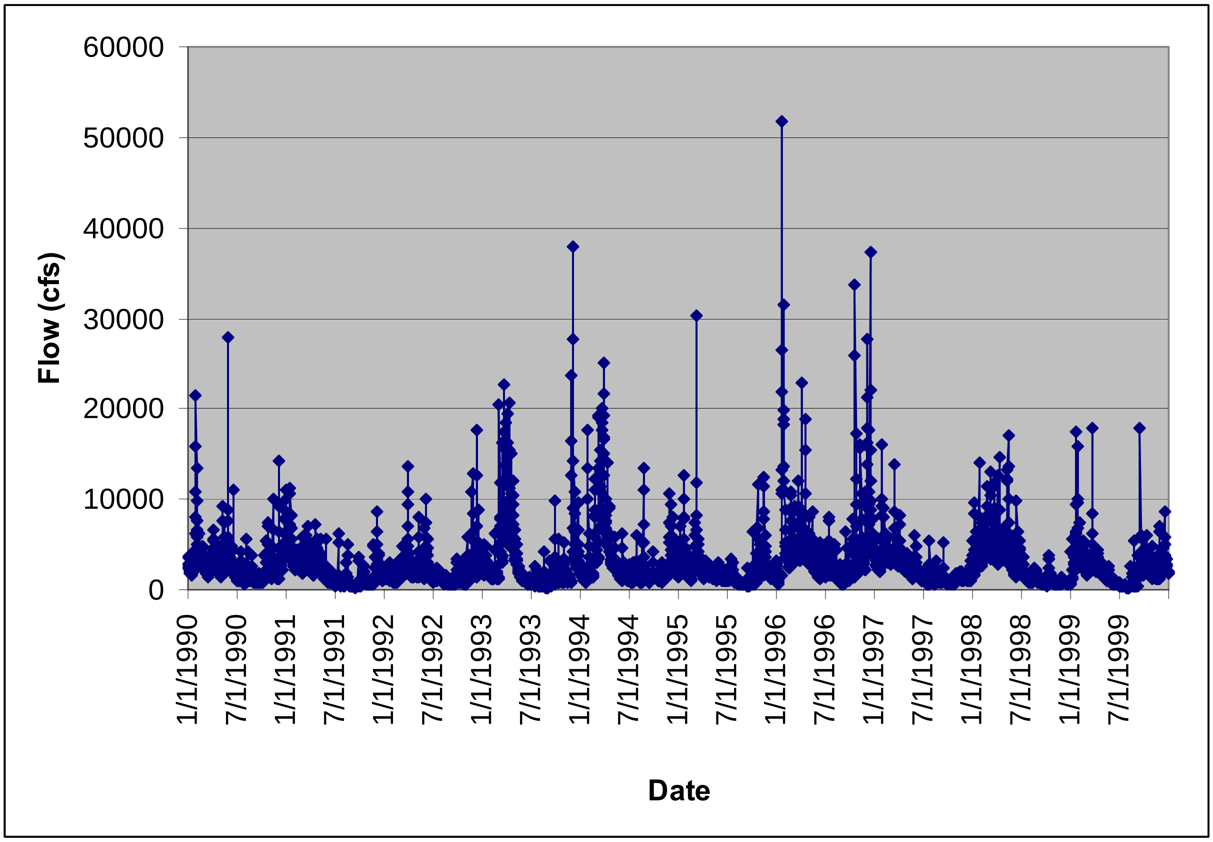
Figure 2.1.4-1 Precipitation trends in Southeastern Pennsylvania through the 1990's





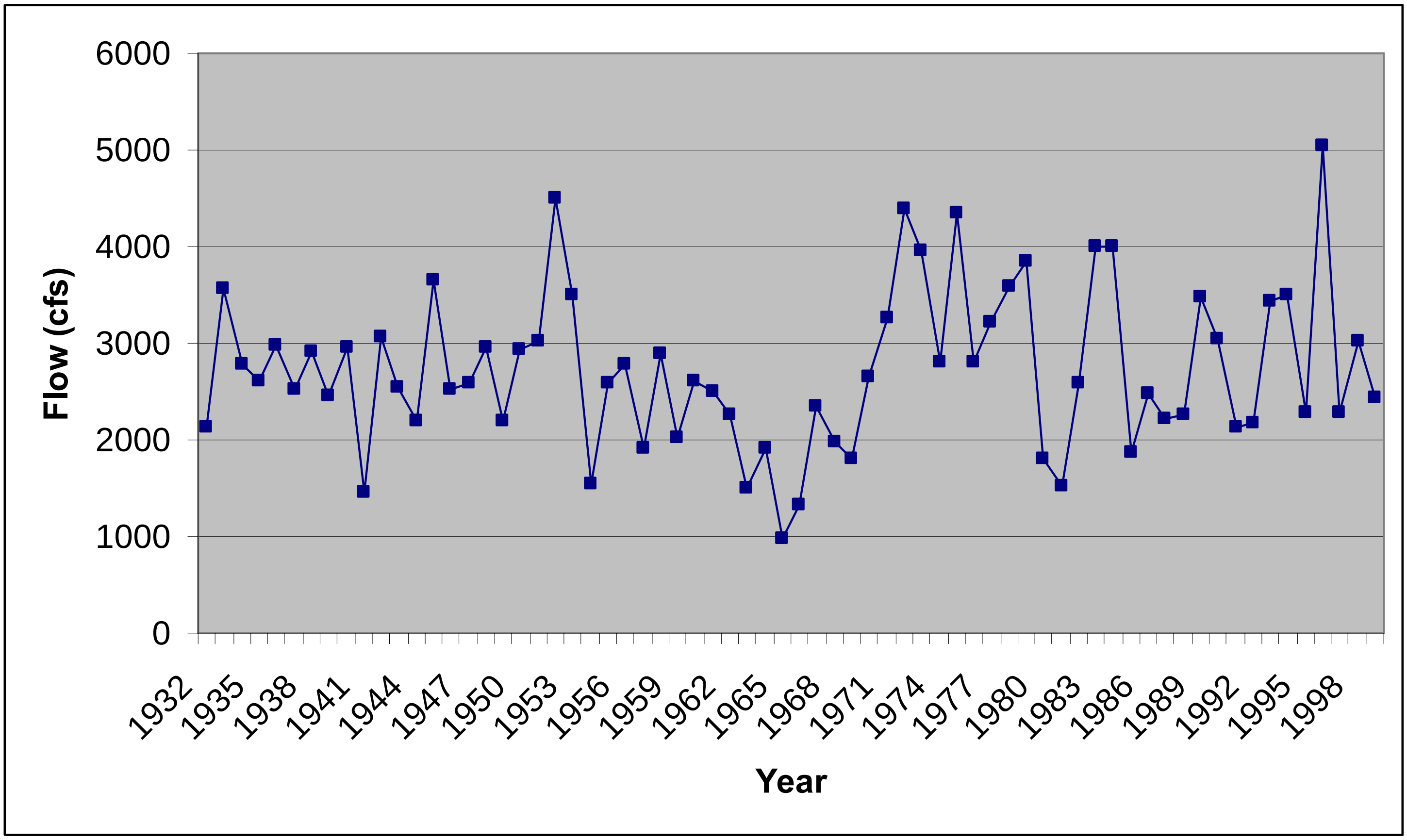
Average annual Schuylkill River flow at Philadelphia is 2,721 CFS. Daily average Schuylkill River flow at Fairmount Dam through the 1990s is summarized in Figure 2.1.4-2 and indicates extremely high flow conditions in January 1996, with less pronounced high flow conditions occurring in 1994 and 1995. Lowest flows through the decade were not always associated with extended low levels of summer precipitation, suggesting that evaporation, groundwater storage, and surface water removal are important components in the water budget of the region. Based on monthly averages, no long-term temporal trends in flow were evident through this period (n = 120, Rho = -0.013, P = 0.884 for non-parametric rank order regression).

Figure 2.1.4-2 Daily Average Schuylkill River Flow at Fairmount Dam through the 1990's



Seasonal variation is driven primarily by precipitation, which is highest in spring, and evaporation, which is highest in summer months. Lowest flows occurred in 1993 and 1999. Minimum flows were higher through the 1990s than earlier in the century (see Figure 2.1.4-3)

Figure 2.1.4-3 Annual Average Schuylkill River Flow through 1930s – 1990s



Surface Water

Runoff generated as overland flow just after a storm in the Schuylkill River Basin has a distinct seasonal variation. The most runoff occurs during winter or early spring, and the lowest amount of runoff occurs during the late summer or early fall. Runoff is chiefly dependent on the amount of rainfall that a specific area receives; after the winter months, the accumulated snow melts in the early spring create additional runoff. During the late summer months, there is very little runoff.

The northern area of the basin, specifically in the area surrounding Tamaqua, receives the most precipitation and runoff, and runoff decreases with the amount of precipitation from north to south. As a result of loss of precipitation by evaporation, transpiration, and consumptive use, only about half of the precipitation falling within the watershed ever reaches surface waters.

Table 2.1.4-1 summarizes the locations, drainage areas, annual mean flows, and annual runoff at 21 gauging stations along the Schuylkill River. The first gauging station listed is the northernmost one located along the Little Schuylkill River. The last gauging station on the chart is located along the lower portion of the Schuylkill River. Table 2.1.4-2 describes the size and location of the various tributaries and drainage areas within the Schuylkill River Basin. As shown, Perkiomen, Tulpehocken and Maiden Creeks are by far the largest tributaries discharging to the Schuylkill River and can have significant impacts on Schuylkill water quality. First order streams comprise approximately 57% of the total stream miles within the Schuylkill River watershed. Figure 2.1.4-4 shows the locations of these first order tributaries.

Table 2.1.4-1 Stream Gauging Data in the Schuylkill River Basin

Station ID	Location	Drainage Area (mi^2)	Period of Record	Annual Mean Flow (cfs)	Annual Runoff (Inches)	10% Exceeds (cfs)	50% Exceeds (cfs)	90% Exceeds (cfs)
01468500	Schuylkill at Landingville	133	1947-1953 1963-1965 1973-1999	278	28.43	560	195	75
01469500	Little Schuylkill at Tamaqua	43	1933-1999	84.2	N/A	177	51	13
01470500	Schuylkill at Berne	355	1947-1999	716	27.41	1480	450	158
01470779	Tulpehocken Creek Near Bernville	67	1975-1999	108	22.13	183	85	43
01470853	[1]Furnace Creek at Robesonia	4	1983-1999	6.87	22.33	14	4.7	1.4
01470960	Tulpehocken Creek at Blue Marsh Dam	175	1979-1999	273	N/A	539	174	65
01471000	Tulpehocken Creek Near Reading	211	1980-1999	320	N/A	625	213	83
01471510	Schuylkill River at Reading	880	1977-1999	1630	N/A	3330	1070	400
01471875	Manatawny Creek Near Spangsville	57	1993-1999	91	21.73	171	58	22
01471980	Manatawny Creek Near Pottstown	86	1974-1999	131	20.86	243	85	34
01472000	Schuylkill River at Pottstown	1147	1928-1999	1909	N/A	3860	1300	473
01472157	French Creek Near Phoenixville	59	1969-1999	89	20.47	170	56	20
01472198	Perkiomen Creek at East Greenville	38	1982-1999	60.4	21.59	115	37	15
01472199	West Branch Perkiomen at Hillegrass	23	1982-1999	38.1	22.43	74	23	7.9
01472620	East Branch Perkiomen Near Dublin	4	1990-1999	41.2	N/A	62	42	13
01472810	East Branch Perkiomen Near	59	1991-1999	126	N/A	191	72	48

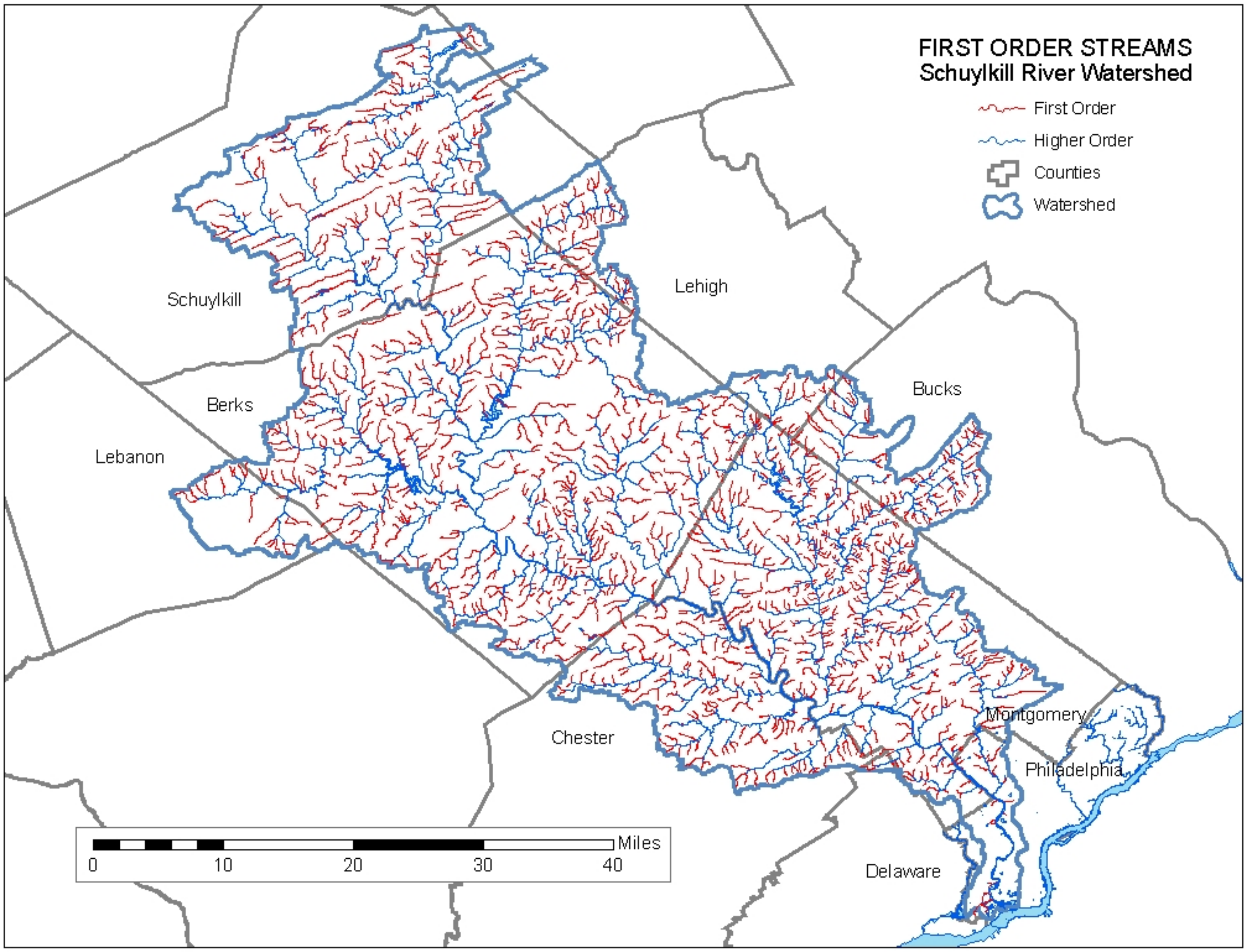
Station ID	Location	Drainage Area (mi^2)	Period of Record	Annual Mean Flow (cfs)	Annual Runoff (Inches)	10% Exceeds (cfs)	50% Exceeds (cfs)	90% Exceeds (cfs)
	Schwenksville							
01473000	Perkiomen Creek at Graterford	279	1957-1999	411	N/A	831	180	60
01473169	Valley Creek Near Valley Forge	21	1983-1999	32.3	21.09	52	23	15
01473900	Wissahickon Creek at Fort Washington	21	N/A	N/A	N/A	N/A	N/A	N/A
01474000	Wissahickon Creek Mouth at Philadelphia	64	1966-1999	104	22.02	177	60	28
01474500	Schuylkill River at Philadelphia	1893	1932-1999	2721	N/A	5850	1670	430

Table 2.1.4-2 Characteristics of Tributaries in the Schuylkill River Watershed (from Top of Watershed to Bottom of Watershed by River Mile Location)

Major Subwatershed	Drainage Area (mi^2)	River Mile Location	Length (mi)
Upper Schuylkill	287.6	>135	49
Little Schuylkill River	136.8	102.1	34.2
Maiden Creek	216.0	86.7	29.3
Tulpehocken Creek	219.2	76.8	37.6
Allegheny Creek	17.9	67.7	11
Hay Creek	22.1	63.1	12.1
Middle Schuylkill 3 (Douglassville - Reading)*	98.1	63-86	23
Monocacy Creek	25.8	60.6	12
Manatawny Creek	91.5	54.2	23.7
French Creek	70.1	35.6	23
Pickering Creek	38.8	34	14.8
Perkiomen Creek	366.3	32.3	37.8
Middle Schuylkill 2 (Phoenixville – Pottstown)*	103.0	32.63	31
Valley Creek	23.3	30.6	10.4
Middle Schuylkill 1 (Norristown – Valley Forge)*	64.8	20.5-32	11.5
Wissahickon Creek	63.6	12.8	24.2
Lower Schuylkill (Philadelphia – Conshohocken)*	69.6	<20.5	20.5

**These watershed boundaries were selected for the purpose of the assessments.*

Figure 2.1.4-4 First Order Tributaries of the Schuylkill River Watershed



Reservoirs

Tulpehocken Creek is host to Blue Marsh Lake, which has a volume of 7.7 billion gallons and is a man-made reservoir maintained and operated by the Army Corps of Engineers near the town of Reading. Other reservoirs/lakes are located within the Schuylkill River Basin. Lake Ontelaunee, a man-made reservoir maintained and operated by the Reading Water Authority, is the primary source of water for the City of Reading. Table 2.1.4-3 provides information about the characteristics of the reservoirs in the watershed. As shown, the detention time in these reservoirs is significant, which impacts both water quality and zone delineation boundaries.

Table 2.1.4-3 Reservoir Characteristics in the Schuylkill River Watershed

Water Body	Average Width	Average Depth	Surface Area	Length	Volume (billions of gallons)	Average Detention Time
Pickering Creek	460 ft	11 ft *	4,804,020 sq ft 0.1723 sq miles	9,395 ft 1.78 miles	0.4	6 hours
Green Lane Reservoir	888 ft	16.4 ft *	43,302,856 sq ft 1.5533 sq miles 996.0 acres	74,648 ft 14.14 miles	4.4 *	1.5 days
Blue Marsh Lake	1073 ft	20.5 ft **	1150 acres ** 1.57 sq miles*** 1012 acres***	42,240 ft ** 63,805 ft *** 12.1 miles***	7.7 **	0.5 days
Lake Ontelaunee	1331 ft	7.2 ft **	1100 acres** 1.61 sq miles*** 1031.4 acres ***	29,354 ft *** 5.5 miles***	3.3 **	5 hours

* *Data from Philadelphia Suburban Water Company*
** *Data obtained from technical reports*
*** *Data obtained from GIS analysis*

Groundwater

There are four principal groups of aquifers in the Schuylkill River Basin: unconsolidated deposits, crystalline rocks, carbonate rocks, and clastic rocks. The best areas for large supplies of groundwater are the areas underlain by carbonate rocks in the Great Valley and the areas underlain by unconsolidated deposits in the Coastal Plain. The basin contains a wide range of rock types, as shown in Figure 2.1.2-1 within the Geology and Soils section, impacting the capacity to store and transmit water.

All aquifers in the Schuylkill River Basin are composed of consolidated rocks, with the exception of the Coastal Plain deposits in Philadelphia and the thick, weathered mantle in a few isolated areas. Groundwater can occur under water table or artesian conditions. Water table conditions are much more common within the Schuylkill River Basin. Below the water table, the spaces between the soil particles can store or transmit water. These areas have high porosities and permeabilities. The consolidated rocks have very little porosity, except for a few of the coarse sandstone beds, and their ability to store and transmit water is small. In most aquifers throughout the basin, water moves through and is stored in openings developed along joints, fractures, faults, and cleavage and bedding planes in the rock. These conditions were formed when rocks were stressed by movements in the earth's crust, and they may be enlarged by solution, earthquakes, and earth tides.

The bedding thickness is probably not an important factor in the permeability of carbonate rocks. Chemical weathering along the fractures is a more important factor, as it enlarges the fractures so that they are large enough to transmit water. A zone of weathered rock underlies the land surface throughout the basin. The thickness of this zone ranges from a few feet to more than 100 feet over some of the limestone terrain. Weathered rock has a higher porosity than unweathered rock, and where it does not contain large amounts of clay, it may have a high permeability.

Groundwater flows at very low velocities. Water that reaches the water table is in contact with the rocks of the aquifer for a much longer time than it is in contact with the atmosphere or soil. Therefore, much of the dissolved solids in groundwater are derived from aquifers. As contact time between the water and the rock increases, the mineral content of the water also increases to the saturation point. Groundwater in many areas may be contaminated by on-site disposal of domestic waste.

Stressed Groundwater Areas

In 1999, The Delaware River Basin Commission (DRBC) adopted regulations that establish groundwater withdrawal limits for 76 watersheds that fall either entirely or partly within the "Groundwater Protected Area" of Southeastern Pennsylvania.

The Protected Area, where more stringent regulations apply to groundwater withdrawals than they do in the rest of the Delaware River Basin, was established by the commission in 1980 at the request of the Commonwealth of Pennsylvania after it became evident that development was negatively impacting groundwater levels. The goal is to prevent depletion of groundwater and to protect the interests and rights of lawful users of the same water source, as well as balance and reconcile alternative and conflicting uses of limited water resources in the region.

Declining water tables in the protected area have reduced flows in some streams that are groundwater fed, resulting in some stream beds that are totally dry. This reduction in baseflow affects downstream water uses, negatively impacts aquatic life, and can reduce the capacity of waterways in the region to assimilate pollutants.

The protected area uses a two-tiered system of water withdrawal limits. The first tier serves as a warning that a sub-basin is "potentially stressed". The second tier establishes a maximum groundwater withdrawal limit. In potentially stressed sub-basins, applicants for new or expanded groundwater withdrawals are required to implement one or more programs to mitigate adverse impacts of additional groundwater withdrawals. Acceptable programs include conjunctive use of groundwater and surface water, expanded water conservation programs, programs to control groundwater infiltration, and artificial recharge and spray irrigation.

The Ground Water Protected Area regulations for Southeastern Pennsylvania also:

- Provide incentives for holders of existing DRBC dockets and protected area permits to implement one or more of the above programs to reduce the adverse impacts of their groundwater withdrawals. If docket or permit holders successfully implement one or more programs, the commission will extend the docket or permit duration for up to ten years;

- Specify criteria for the issuance and review of dockets and permits as well as procedures for revising withdrawal limits to correspond with integrated water resource plans adopted by municipalities for sub-basins; and

- Establish protocol for updating and revising withdrawal limits to provide additional protection for streams designated by the Commonwealth of Pennsylvania as "high quality," or "wild, scenic, or pastoral," as defined by the state's Scenic Rivers Program.

The Ground Water Protected Area includes 1,200 square miles and 127 municipalities. In addition to the Neshaminy Creek watershed, other large drainage areas include the Brandywine Creek, Perkiomen Creek, and Wissahickon Creek sub-basins.

All of **Montgomery County falls within the protected area, as do** the following areas in surrounding counties:

Berks: the townships of Douglass, Hereford, and Union.

Bucks: the townships of Bedminster, Buckingham, Doylestown, East Rockhill, Hilltown, Lower Southampton, Middletown, Milford, New Britain, Newtown, Northampton, Plumstead, Richland, Upper Southampton, Warminster, Warrington, Warwick, West Rockhill, and Wrightstown; the boroughs of Chalfont, Doylestown, Dublin, Hulmeville, Ivyland, Langhorne, Langhorne Manor, New Britain, Newtown, Penndel, Perkasie, Quakertown, Richlandtown, Sellersville, Silverdale, Telford, and Trumbauersville.

Chester: the townships of Birmingham, Charlestown, East Bradford, East Coventry, East Goshen, East Pikeland, Easttown, East Vincent, East Whiteland, North Coventry, Schuylkill, South Coventry, Thornbury, Tredyffrin, Warwick, West Bradford, West Goshen, Westtown, Willistown, and West Whiteland; the boroughs of Elverson, Malvern, Phoenixville, Spring City and West Chester.

Lehigh: Lower Milford Township.

2.1.5 Analysis of Stream Impairments and Sources

In accordance with Section 305(b) of the Federal Clean Water Act, PADEP prepared a 305(b) Water Quality Assessment Report in 2003. The report indicates where water quality problems have been identified, and summarizes water quality management programs, water quality standards, and point and non-point source controls. The Schuylkill River watershed includes 2,770 miles of streams and creeks. Ninety-eight percent of the stream miles (2,725 miles) within the watershed have been assessed in order to determine compliance with applicable water quality standards. Streams where the water quality standards are not met are designated as impaired. Where information exists, the most likely sources of contamination (point sources, or non-point sources such as stormwater runoff or abandoned mine drainage) are also identified. To date, approximately 35% of the assessed streams in the watershed have been designated as impaired. Figure 2.1.5-1 and Table 2.1.5-1 show the total number of impaired stream miles within each subwatershed.

Figure 2.1.5-1 Impaired Miles vs. Miles Assessed in Each Watershed (2003 305(b) Water Quality Assessment Report)

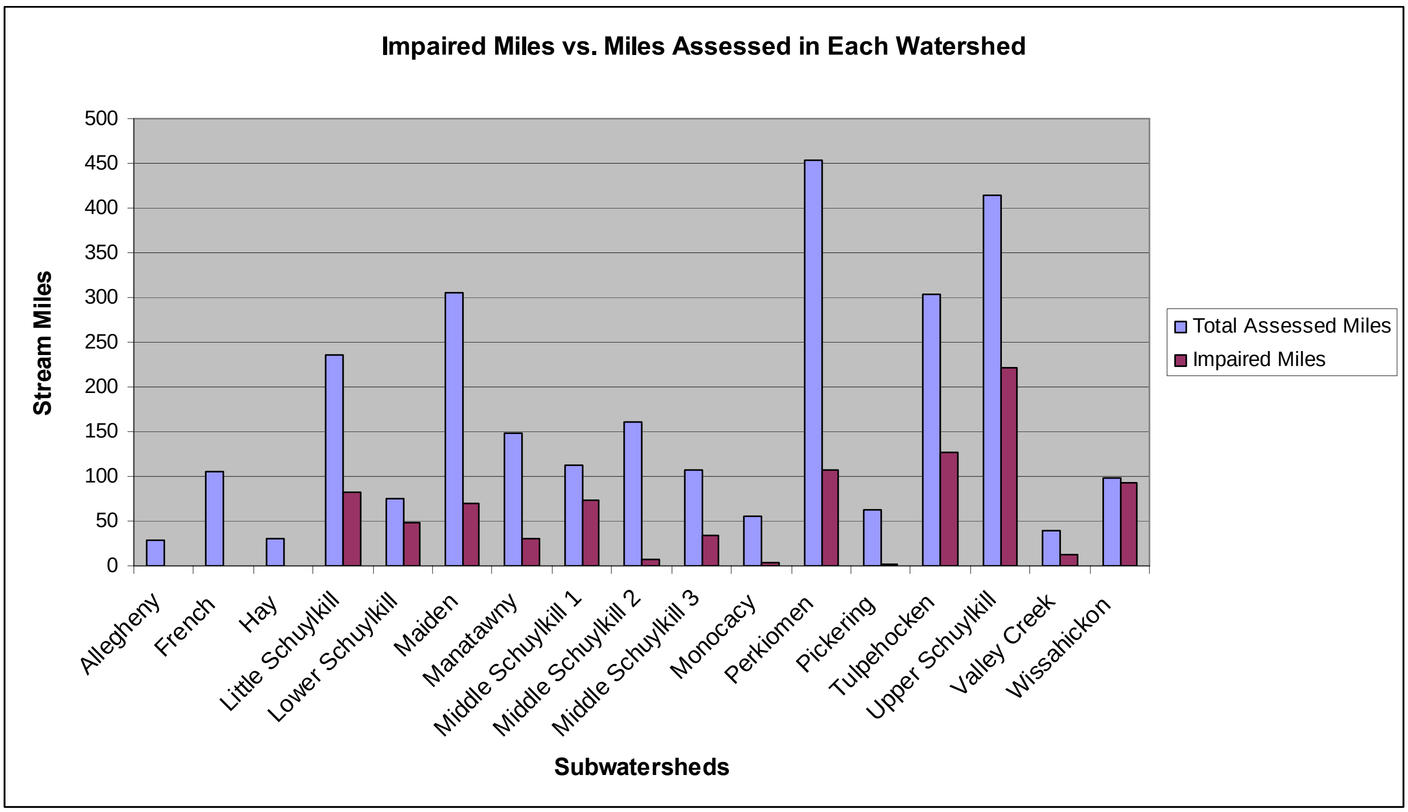


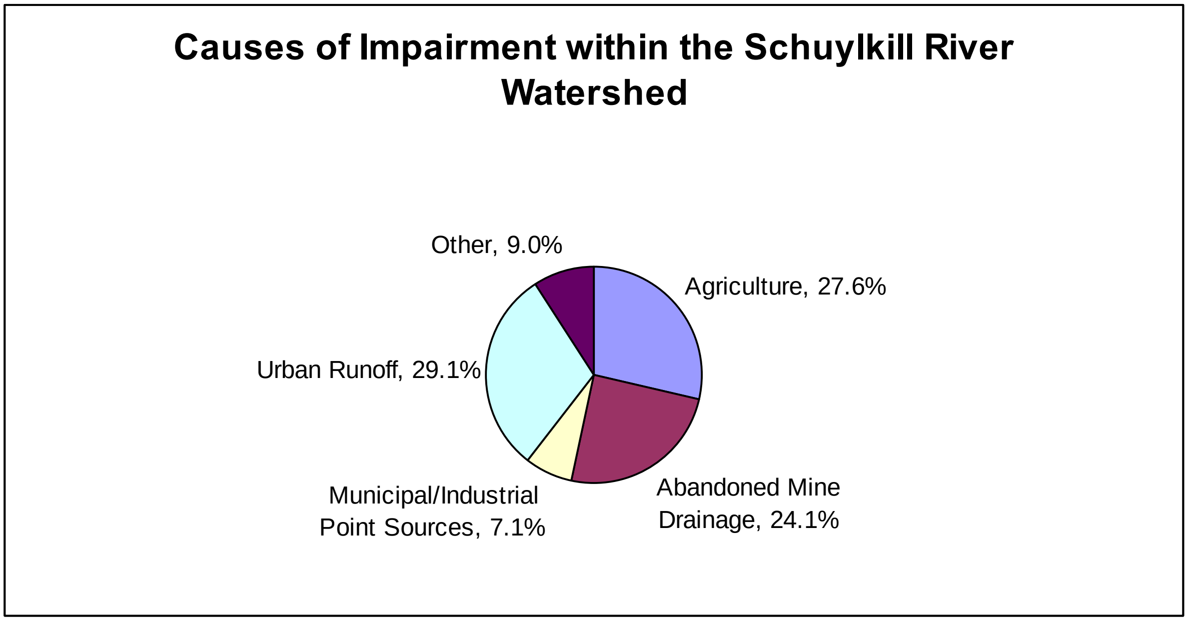
Table 2.1.5-1 Total Number of Impaired Stream Miles by Subwatershed

Subshed	Total Impaired Miles	% of Subshed Impaired
Allegheny	0	0.00%
French	0	0.00%
Hay	0	0.00%
Little Schuylkill	82.07	45.19%
Lower Schuylkill	48.6	58.77%
Maiden	69.95	22.68%
Manatawny	31.25	25.12%
Middle Schuylkill 1	73.38	74.80%
Middle Schuylkill 2	7.47	4.56%
Middle Schuylkill 3	34.63	25.52%
Monocacy	2.9	5.21%
Perkiomen	106.76	16.74%
Pickering	1.82	2.89%
Tulpehocken	127.59	44.89%
Upper Schuylkill	221.69	62.50%
Valley Creek	12.42	36.00%
Wissahickon	92.37	100.00%

The Wissahickon Creek, Lower Schuylkill, and Middle Schuylkill 1 subwatersheds have the greatest percentages of impaired stream miles. No impairments were identified in the Allegheny Creek, French Creek, and Hay Creek subwatersheds.

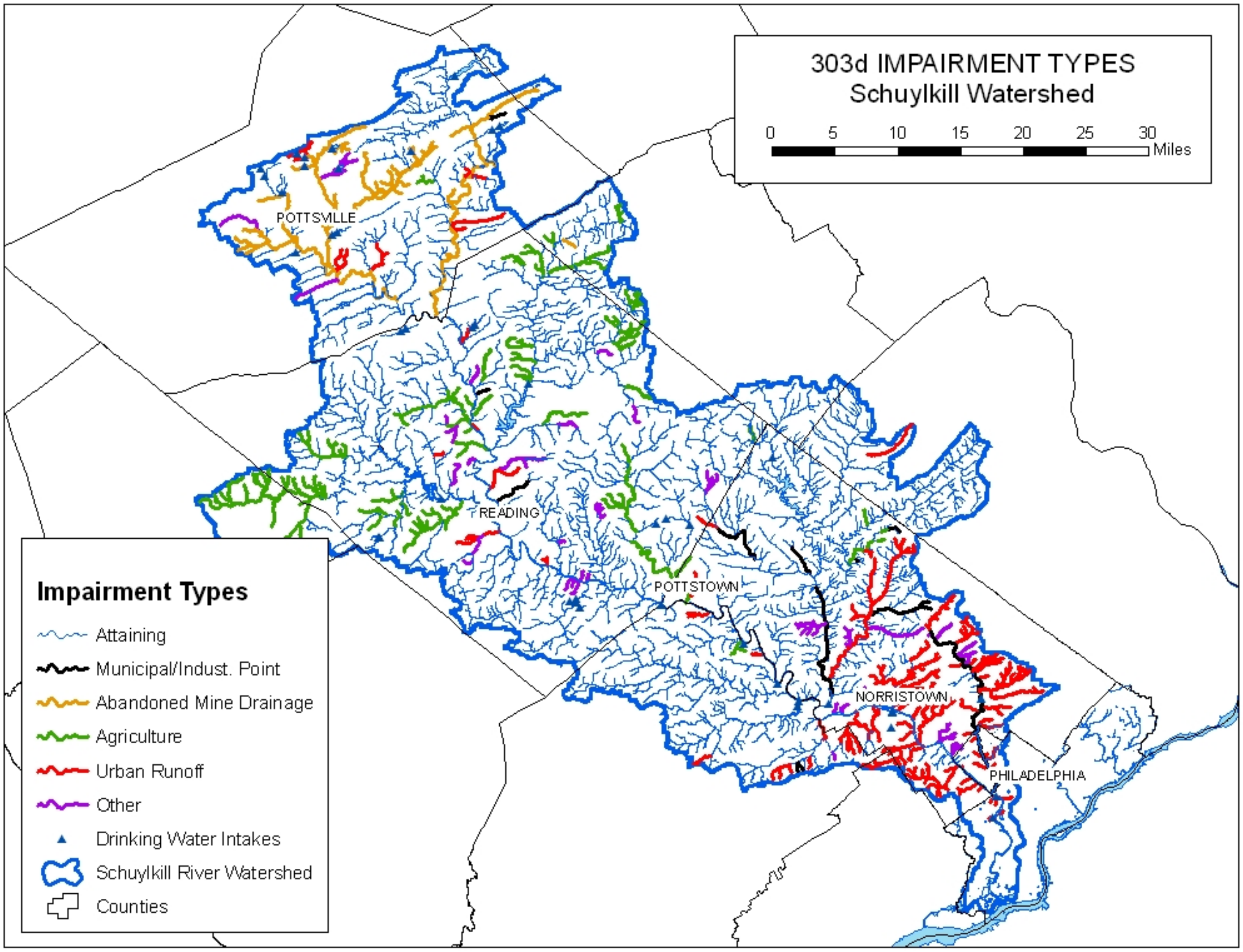
Abandoned mine drainage, agricultural land use impacts, urban/suburban stormwater runoff, and permitted dischargers have all been identified as causes of impairment in the Schuylkill River watershed. Figure 2.1.5-2 summarizes the percentage of miles impaired by each potential cause of impairment. “Other” sources include flow alterations, siltation, and pesticides. The leading cause of impairment in the watershed is urban/suburban runoff, followed closely by agricultural runoff and abandoned mine drainage.

Figure 2.1.5-2 Causes of Impairment within the Schuylkill River Watershed



As seen below in Figure 2.1.5-3, impaired stream reaches are most common in the Lower Schuylkill watershed and are due to municipal point sources, urban runoff, and "other" causes related to development. Impairment causes vary by region. Abandoned mine drainage is the primary source of impairment in the upper watershed while agricultural impacts affect the Berks County area within the middle Schuylkill watershed.

Figure 2.1.5-3 Locations of Impaired Stream Reaches in the Schuylkill River Watershed

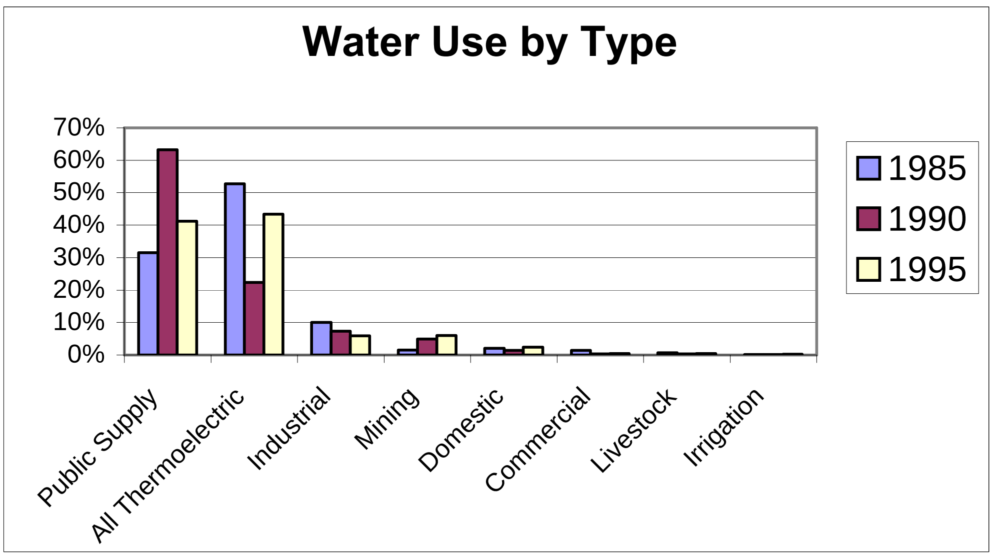


2.2. Surface Water Intakes

2.2.1 Water Usage

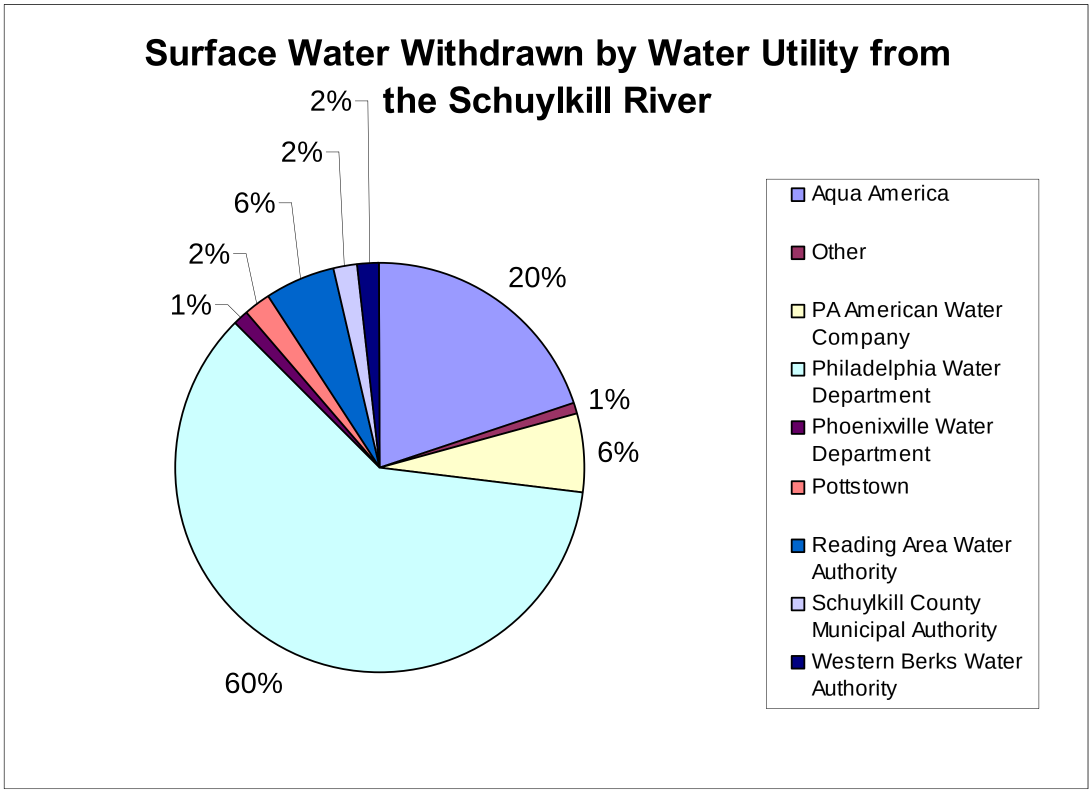
USGS estimates that over 669 million gallons of water are withdrawn per day from the Schuylkill River watershed. Over 76% of that water is withdrawn from surface sources such as streams, lakes, reservoirs, and the river itself. As shown in Figure 2.2.1-1, most of the water withdrawn from the watershed is used for water supply and thermoelectric power for cooling.

Figure 2.2.1-1 Percentage of Total Water Withdrawal from the Schuylkill River Watershed by Use Category



Approximately 244 million gallons of water per day are withdrawn from the river and its tributaries to provide drinking water to over 1.5 million people. PWD's Belmont intake is the first public water supply intake on the Schuylkill River above the confluence with the Delaware River. The Tamaqua Area Water Authority's Still Creek intake is the northernmost drinking water source in the watershed and is located in upper Schuylkill County. As shown in Figure 2.2.1-2, the Philadelphia Water Department, Aqua America, and Pennsylvania American Water Company withdraw over 85% of the water supplied for potable use. Their intakes are located in the lower portion of the Schuylkill River watershed.

Figure 2.2.1-2 Percentage of Surface Water Withdrawn from the Schuylkill River Watershed by Water Suppliers (1999-2000)



PWD's Belmont Water Treatment Plant (PWSID# 1510001) is located ten miles from the mouth of the Schuylkill River in Philadelphia County. Raw water is pumped from the Schuylkill River at a daily average rate of 60 million gallons per day (MGD) with a maximum capacity of 90 MGD. Located just south of City Line Avenue, the Belmont treatment plant services the entire region of Philadelphia west of the Schuylkill River. Treated water from the Belmont WTP is delivered to about 270,000 people or 17% of the population of the west and southwest regions of the City of Philadelphia. The Queen Lane Water Treatment Plant (PWSID 1510001) is located 12 miles from the mouth of the Schuylkill River in Philadelphia County. Raw water is pumped from the Schuylkill River at a daily average flow rate of 85 MGD. Located in the East Falls section of the city, the Queen Lane Water Treatment Plant provides water to approximately 900,000 people in the northwest region of Philadelphia. The service area is outlined by the Schuylkill River to the west, Roberts Avenue and Tabor Road to the south, and the borders of the city to the north and east.

Figure 2.2.1-3 shows the locations of the Queen Lane and Belmont intakes, along with the 40 other drinking water intakes in the Schuylkill watershed. Table 2.2.1-1 shows the water supplier intake ID used in each of the figures.

Figure 2.2.1-3 Locations of Water Supply Intakes in the Schuylkill River Watershed

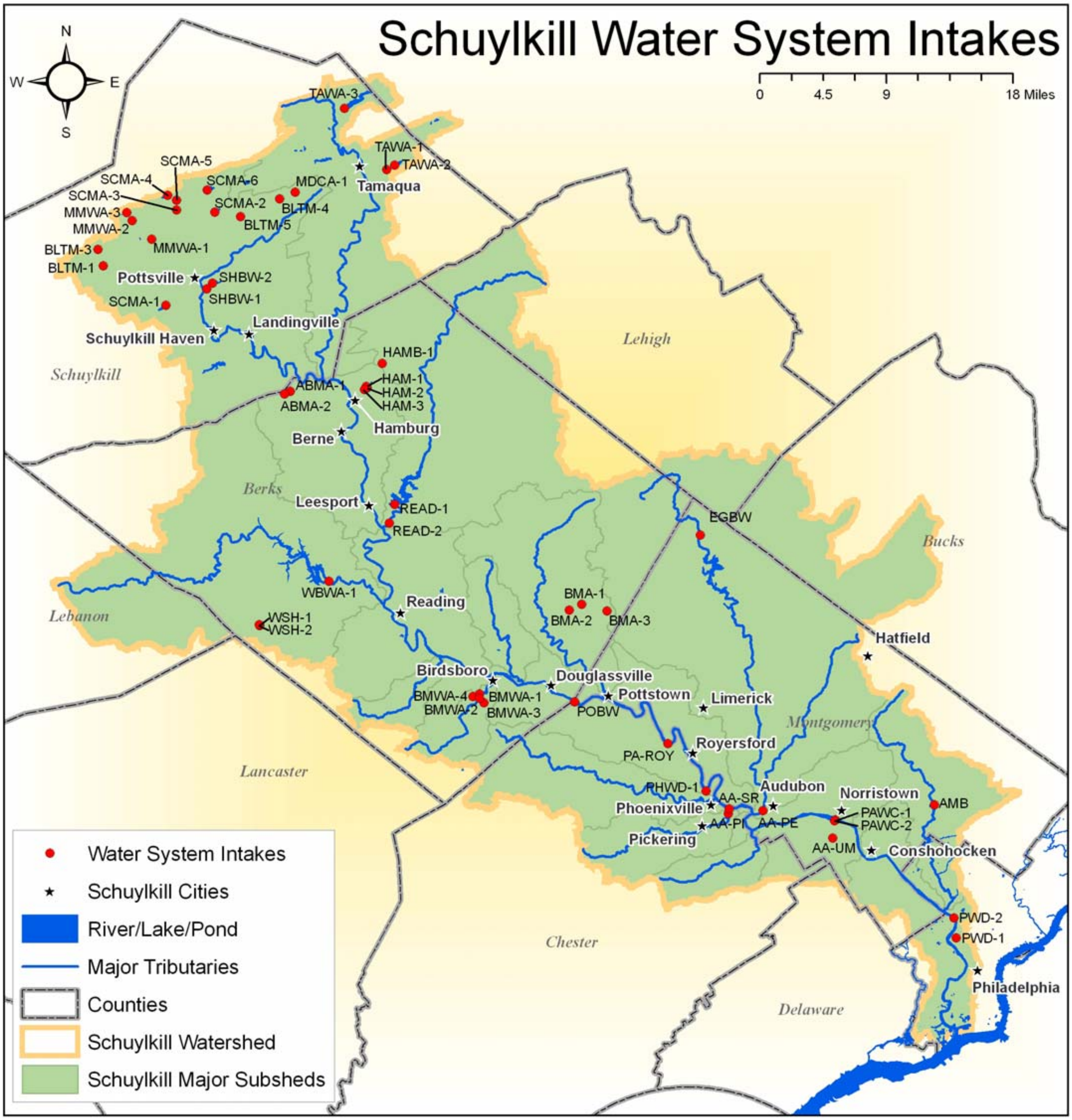


Table 2.2.1-1 Water System Intake IDs

Intake ID	Water System Name	Source Name
AA-PE	Aqua America	Perkiomen Creek
AA-PI	Aqua America	Pickering Creek
AA-SR	Aqua America	Schuylkill River
AA-UM	Aqua America	Upper Merion Quarry
ABMA-1	Auburn Borough	Bear Creek Reservoir
ABMA-2	Auburn Borough	Stony Creek Reservoir
AMB	Ambler Borough Water Department	Whitemarsh Spring
BMA-1	Boyertown Water Authority	Popodickon Reservoir
BMA-2	Boyertown Water Authority	Trout Run Reservoir
BMA-3	Boyertown Water Authority	Ironstone Creek
BMWA-1	Birdsboro Municipal Water Authority	Dyer/Trap Rock Quarry
BMWA-2	Birdsboro Municipal Water Authority	Hay Creek
BMWA-3	Birdsboro Municipal Water Authority	Indian Run Reservoir
BMWA-4	Birdsboro Municipal Water Authority	Stinson Run Reservoir
BLTM-1	Blythe Township Municipal Authority	Crystal Creek
BLTM-3	Blythe Township Municipal Authority	Glen Dower
BLTM-4	Blythe Township Municipal Authority	Moss Glen
BLTM-5	Blythe Township Municipal Authority	Silver Creek
EGBW	East Greenville Borough Water Department	Perkiomen Creek
HAM-1	Hamburg Centre State Hospital (inactive)	Jones Dam
HAM-2	Hamburg Centre State Hospital (inactive)	Winks Dam
HAM-3	Hamburg Centre State Hospital (inactive)	Impoundment
HAMB-1	Hamburg Municipal Water & Sewer Authority	Furnace Creek
MDCA-1	Mary D Community Association	Reservoir
MMWA-1	Minersville Municipal Water Authority	Reservoir 1
MMWA-2	Minersville Municipal Water Authority	Reservoir 2
MMWA-3	Minersville Municipal Water Authority	Reservoir 3
PAWC-1	PA American Water Company	Schuylkill River
PAWC-2	PA American Water Company	Schuylkill River
PAWC-ROY	PA American - Royersford	Schuylkill River
PHWD-1	Phoenixville Water Department	Schuylkill River
POBW	Pottstown Borough Water Authority	Schuylkill River
PWD-1	Philadelphia Water Department	Schuylkill River
PWD-2	Philadelphia Water Department	Schuylkill River
READ-1	Reading Area Water Authority	Lake Ontelaunee
READ-2	Reading Area Water Authority	Maiden Creek
SCMA-1	Schuylkill County Municipal Authority	Indian Run
SCMA-2	Schuylkill County Municipal Authority	Wolfe Creek
SCMA-3	Schuylkill County Municipal Authority	Pine Run
SCMA-4	Schuylkill County Municipal Authority	Mt Laurel
SCMA-5	Schuylkill County Municipal Authority	Kauffman
SCMA-6	Schuylkill County Municipal Authority	Eisenhuth
SHBW-1	Schuylkill Haven Borough Water	Tumbling Run (Lower)
SHBW-2	Schuylkill Haven Borough Water	Tumbling Run (Upper)
TAWA-1	Tamaqua Area Water Authority (abandoned)	Owl Creek Lower

TAWA-2	Tamaqua Area Water Authority (abandoned)	Owl Creek Upper
TAWA-3	Tamaqua Area Water Authority	Still Creek
WBWA-1	Western Berks Water Authority	Tulpehocken Creek
WSH-1	Wernersville State Hospital	Spring Creek
WSH-2	Wernersville State Hospital	Hospital Creek

2.2.2 Zone Delineations

The Schuylkill River watershed receives water from a drainage area greater than 2,000 square miles. The recently completed Source Water Assessments used a systematic approach to identify and examine the potential contaminant sources in such a large area. This approach, as defined by PADEP's SWAP Plan, involved a segmentation approach that divided the watershed into zones based on the proximity of a potential contaminant source to a water supply intake. This method assumes that proximity is directly linked to a potential source's impact on a water supply. Using this logic, the assessment divided the watershed area for a given intake into the following three zones and prioritized all contaminant sources accordingly:

Zone A – This is the critical area of highest potential impact on the water supply, because proximity to the water supply's intake results in reduced response times and potentially lower dilution and attenuation of a contaminant. Any potentially significant source within a five-hour time of travel of the water supply including one-quarter mile downstream and within a one-quarter mile-wide area on either side of the river/stream from the water supply, was included in the contaminant inventory. These may include large and small discharges, catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

Zone B – This is the area between the 5-hour and 25-hour time of travel to a given water supply intake, including a two mile-wide area on either side of the river or stream extending upstream to the 25-hour time of travel boundary. Only significant potential sources of contamination are identified for inclusion in the contaminant inventory. This generally represents larger dischargers (>one million gallons per day), catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

Zone C – This is the area greater than 25-hour time of travel to a given water supply intake. All major potential sources of contamination were identified, but received a low priority within the contaminant inventory.

All of the zones of delineation were determined and provided by United States Geological Survey (USGS) and approved by PADEP for use in the source water assessments.

Figures 2.2.2-1 through 2.2.2-4 show the Zone A and B delineations for PWD's Belmont and Queen Lane intakes. Similar zone delineations were made for each of the 42 intakes in the Schuylkill watershed during the assessment process. PWD was not funded to complete a source water assessment for the Reading Area Water Authority under its original source water assessment grant. Therefore, a time of travel calculation was derived based upon the mean flow in Maiden Creek of 296 cfs. (Center for Watershed Stewardship, 2000) Potential point and non-point sources for this intake were taken from the *Watershed Assessment for Reading, Pennsylvania* conducted by the Cadmus Group, Inc. in 1998. In addition, PWD was not funded to complete the assessments for Blythe Township Municipal Authority and Hambug Municipal Water & Sewer Authority. These assessments were completed by Spotts, Stevens & McCoy, Inc. and PADEP's Southeast and Northeast Regional Offices, respectively.

Figure 2.2.2-1 PWD's Belmont Intake: Zone A

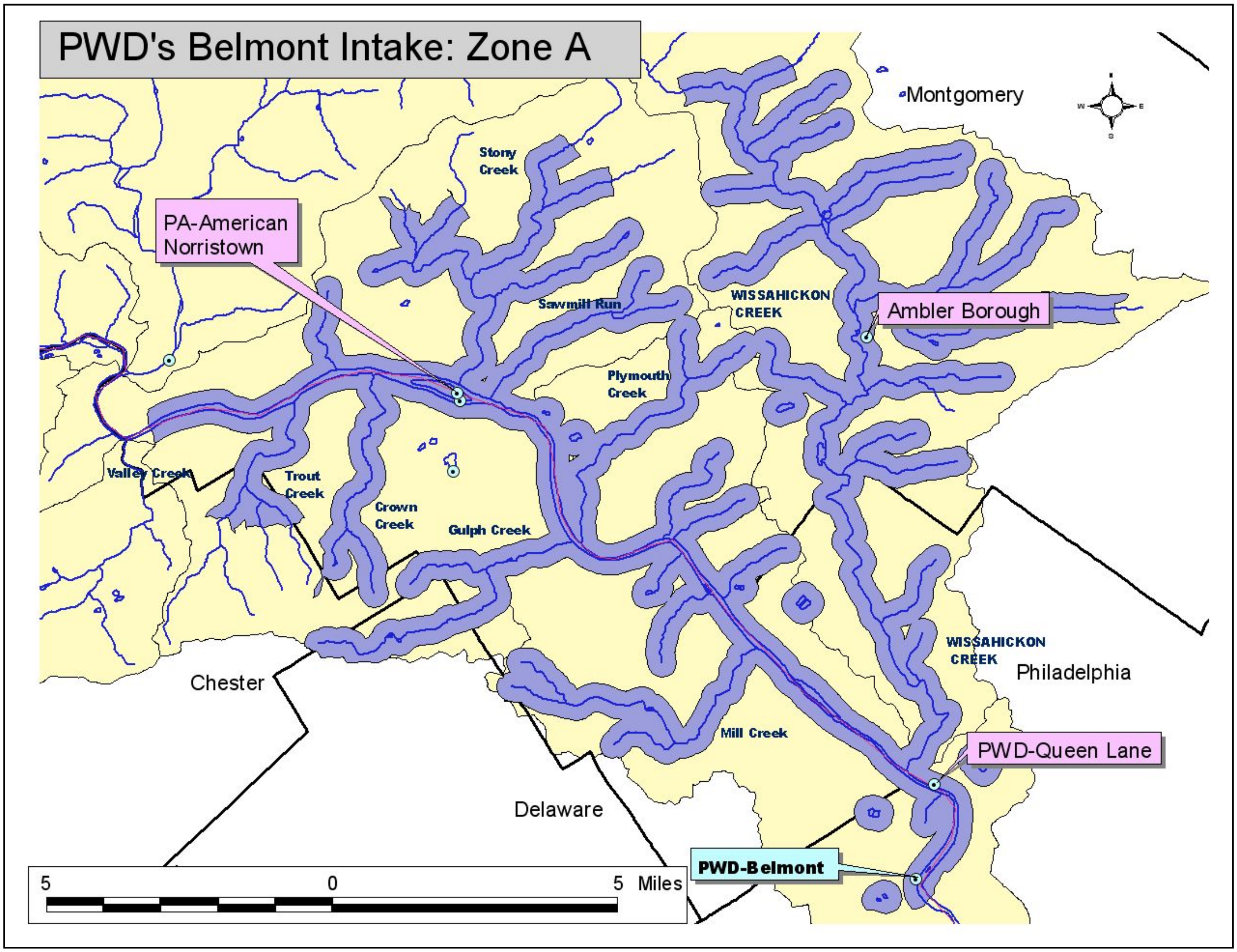


Figure 2.2.2-2 PWD's Belmont Intake: Zone B

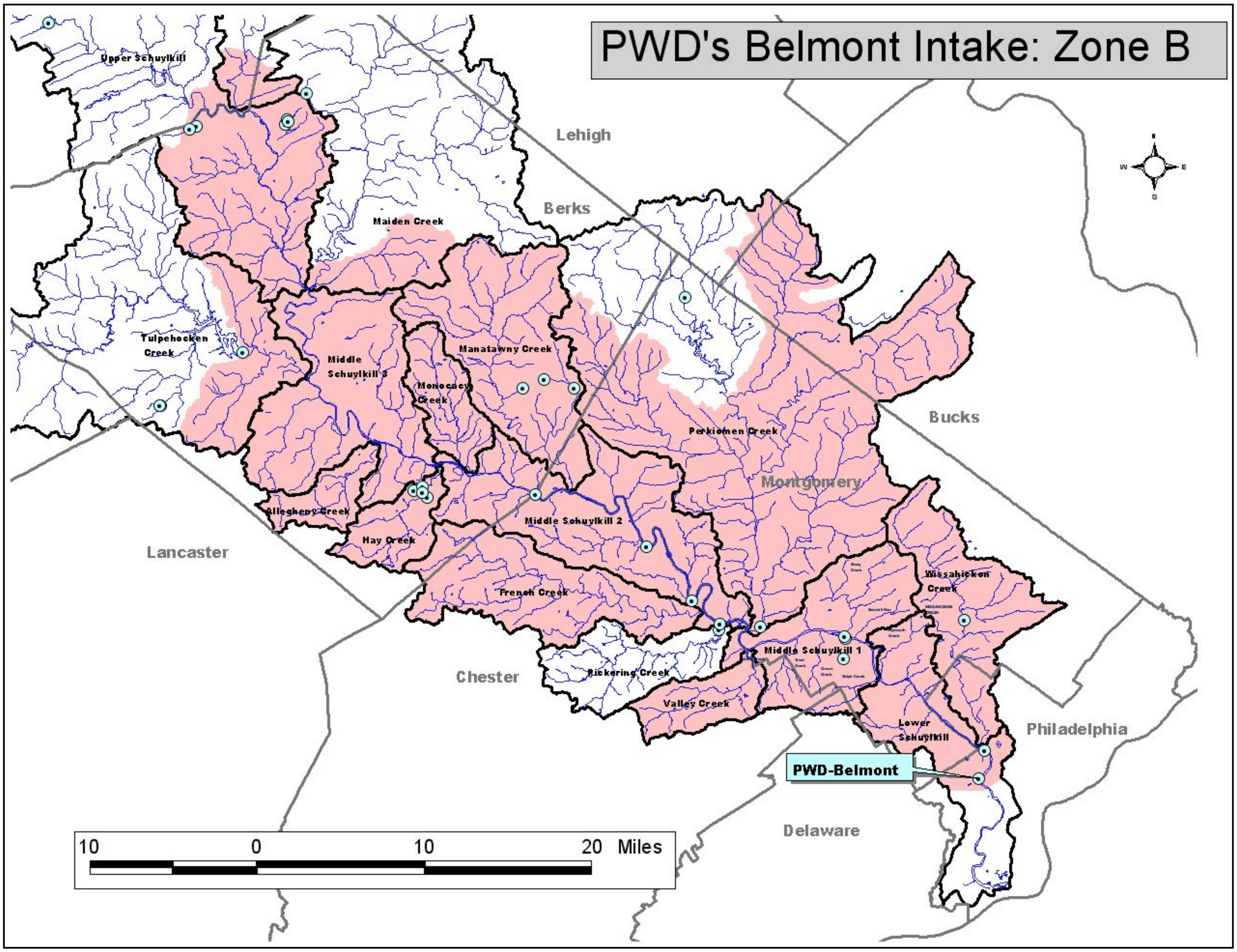


Figure 2.2.2-3 PWD's Queen Lane Intake: Zone A

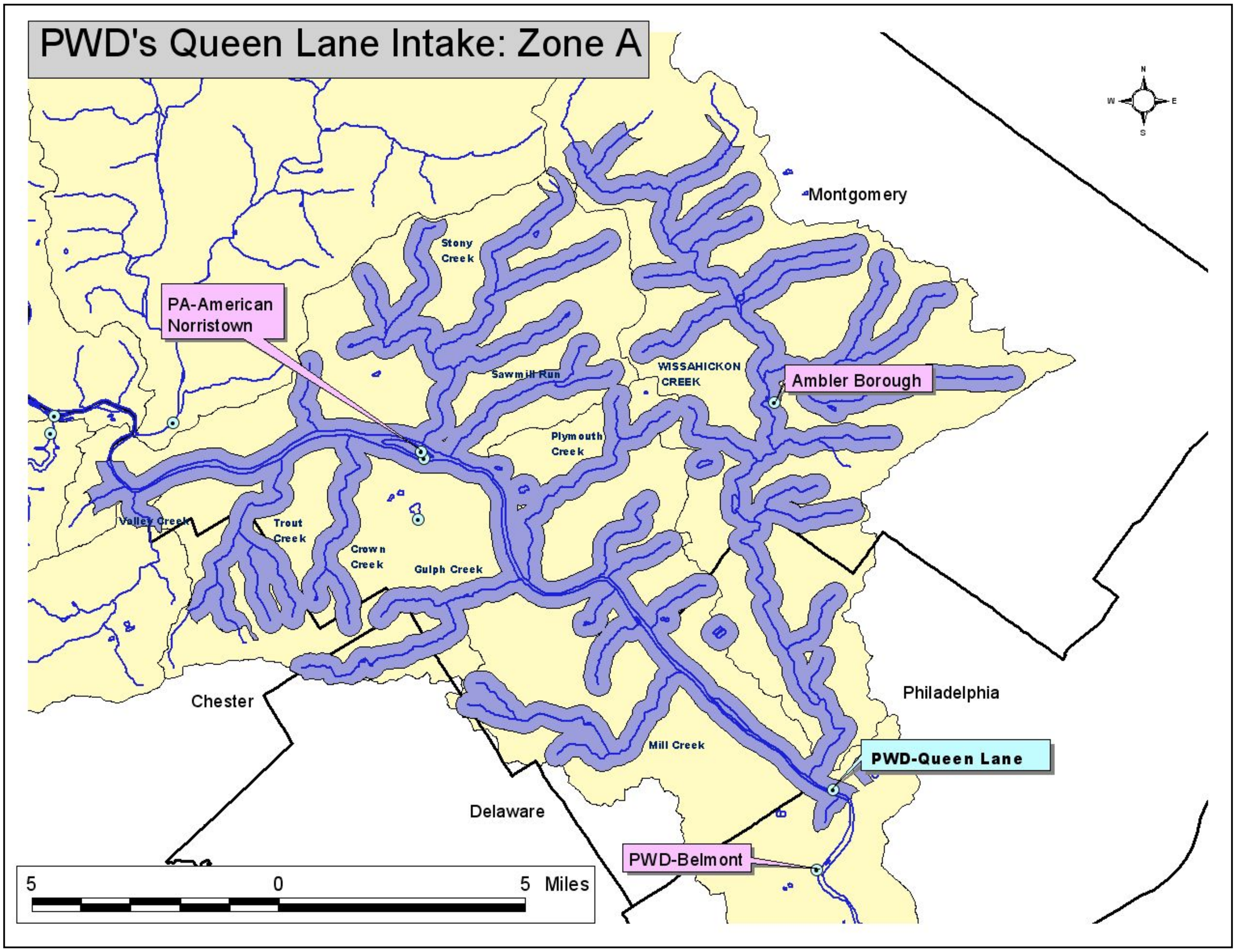
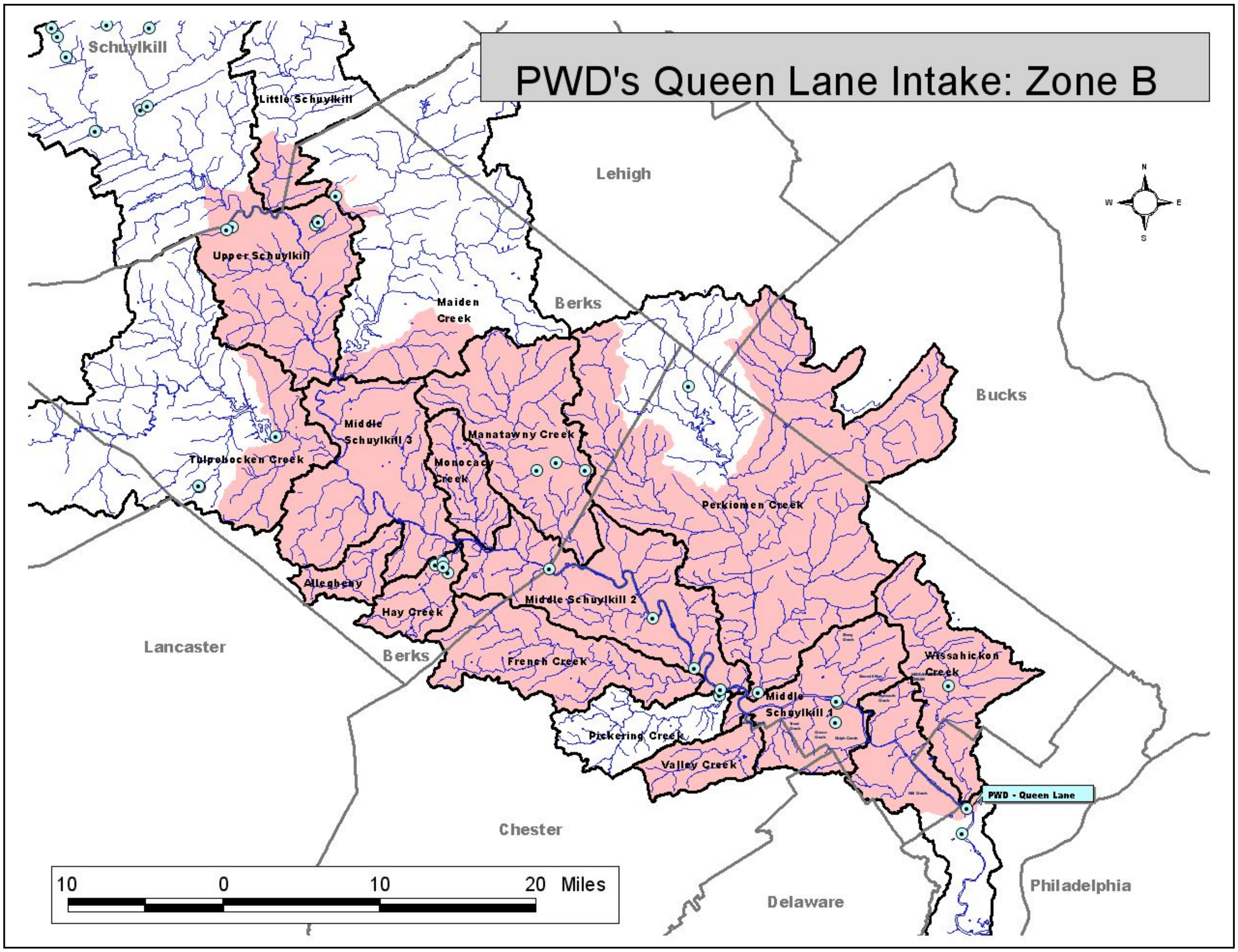
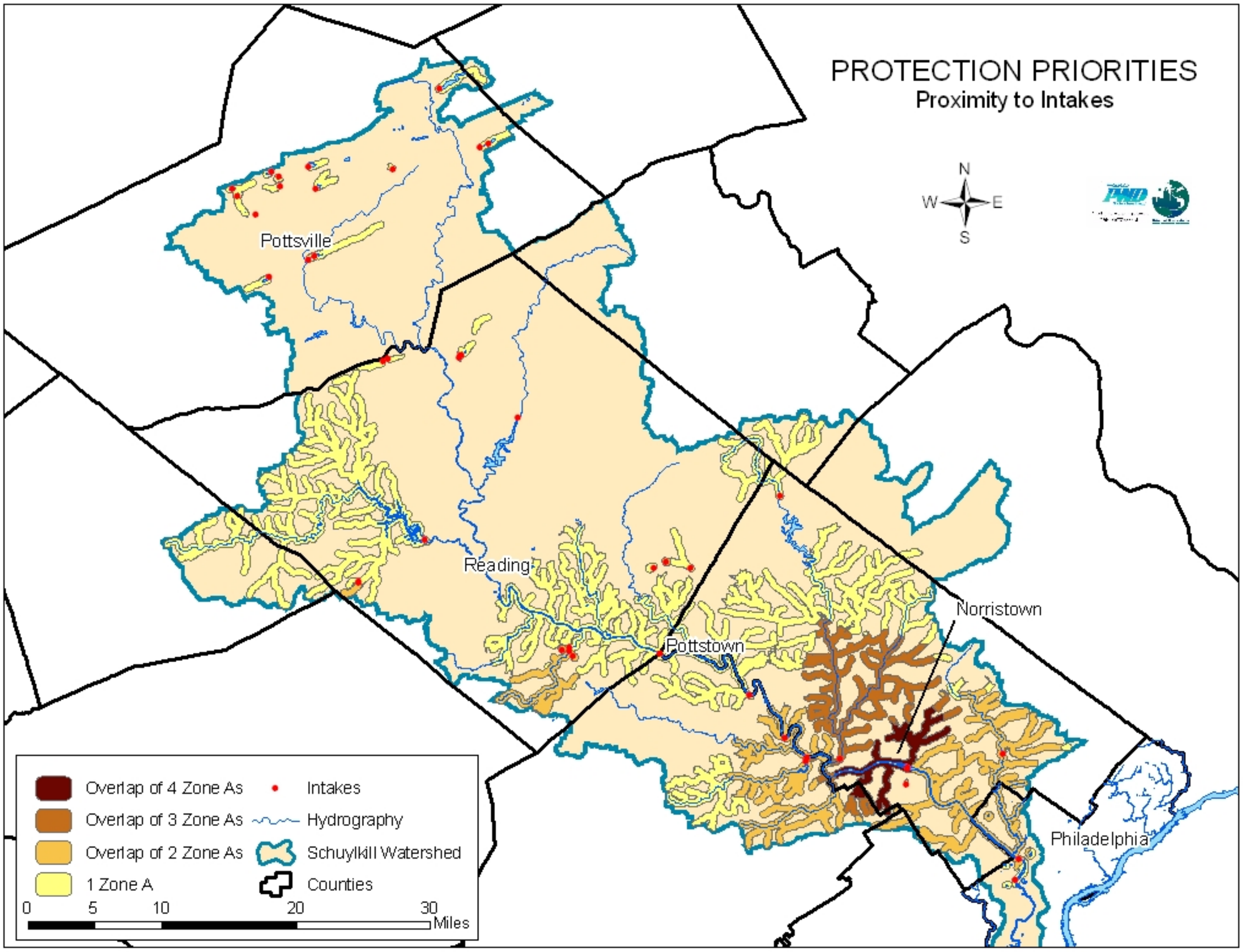


Figure 2.2.2-4 PWD's Queen Lane Intake: Zone B



In an effort to identify large areas of land to protect or preserve from a drinking water perspective, PWD analyzed the Zone A delineations of the 42 drinking water intakes in the Schuylkill River watershed. Figure 2.2.2-5 shows the protection priority areas based upon their proximity to a drinking water intake. As seen in the figure, the areas of Lower Providence, Upper Merion, West Norriton, East Norriton, and Bridgeport are all within the Zone A of four water suppliers.

Figure 2.2.2-5 Protection Priority Areas Based on Proximity to Intake



2.3 Land Use in the Watershed

2.3.1 Existing Land Use

Parts of 11 counties are located within the Schuylkill River watershed. Of these 11 counties, only four (Berks, Chester, Montgomery, and Schuylkill counties) have nearly 10% or more of the watershed within their boundaries (Figure 2.3.1-1) Berks, Chester, and Montgomery counties represent nearly 70% of the land area in the Schuylkill River watershed. Berks County itself comprises 40%, or 750 square miles, of the watershed and is almost completely within the watershed boundaries, suggesting that land use activities within the county can have significant impacts on river water quality. More than 80% of the total land area of both Berks and Montgomery counties lies within the watershed, as shown in Figure 2.3.1-2.

Figure 2.3.1-1 Percentage of Land Area in the Schuylkill River Watershed within Each County

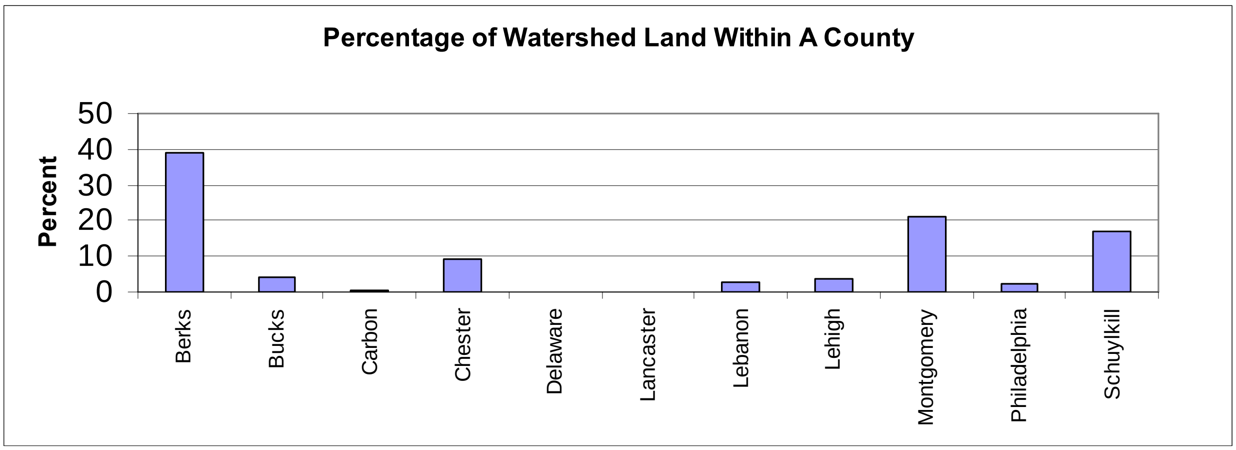
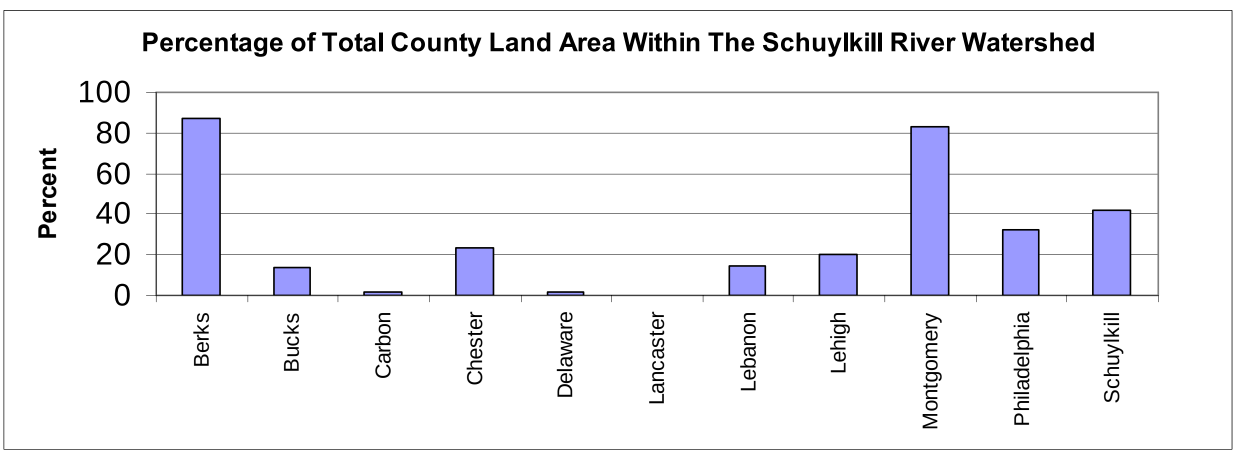


Figure 2.3.1-2 Percentage of Total County Land Area within the Schuylkill River Watershed



Philadelphia County, located at the downstream end of the watershed, accounts for only two percent of the watershed land area, but represents the single largest population and water supply withdrawal in the watershed. Bucks, Montgomery, Chester, and Delaware counties, which border Philadelphia, are in the middle of the watershed and represent suburban areas surrounding the city with varying amounts of development. Berks, Carbon, Lebanon, Lehigh, and Schuylkill Counties make up the upper reaches of the watershed and are the least developed areas.

During the source water assessments a land use characterization of the Schuylkill watershed was completed which included a review of the United States Department of Agriculture (USDA), Delaware Valley Regional Planning Commission (DVRPC), and the United States Geologic Survey (USGS) data inventories. Development of these three characterizations differed in approach, and hence, yielded different assessments of land use. However, all three characterizations indicated that development within the Schuylkill River watershed continues to increase. Since USGS' data set is more detailed and includes the entire watershed, it was selected for the runoff loading model, as described later in the build out model methodology of this source water protection plan. The USDA, DVRPC and USGS characterizations of land use within the Schuylkill River watershed are each described below.

USDA National Resources Inventory
As shown in Figure 2.3.1-3, the most recent studies by the USDA have estimated that the Schuylkill River watershed is 28% developed, 34% agricultural, and 32% forested land. Table 2.3.1-1 and Figure 2.3.1-4 summarize the changes in land use that have occurred during the period from 1982 until 1997. The changes in land use during this time indicate that the amount of developed land in the watershed has increased by over 30% in the past 15 years, while agricultural land has decreased by almost 14%. Forested lands decreased by just fewer than five percent.

Figure 2.3.1-3 Overview of Schuylkill River Watershed Land Use (%)

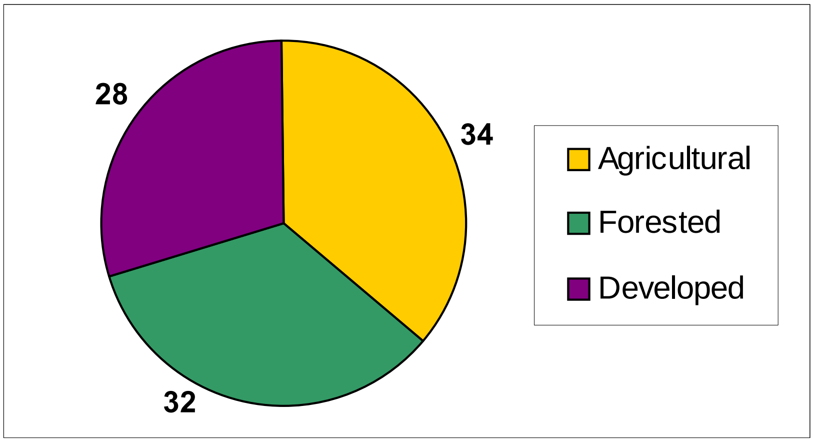
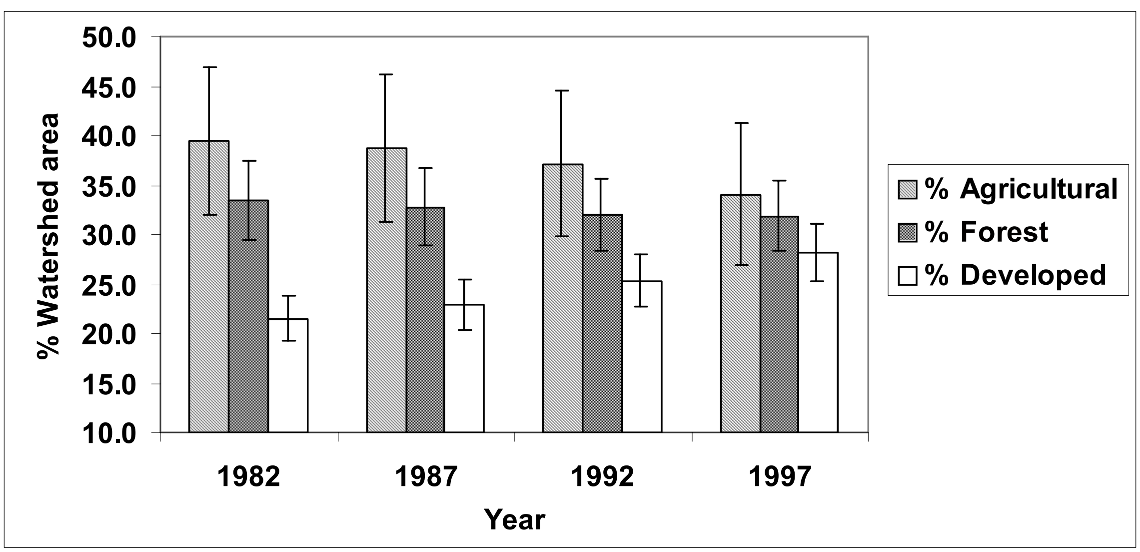


Table 2.3.1-1 Land Use Changes in the Schuylkill River Watershed: 1982-1997

Year	% Agricultural	% Developed	% Forested
1982	39.5	21.5	33.5
1987	38.8	22.8	32.8
1992	37.2	25.3	32.1
1997	34.0	28.3	31.9

Source: NRI, 2001
*Note: To calculate % change in agricultural land from 1982 to 1997: [(34.0-39.5)/39.5] * 100 = -13.9%*

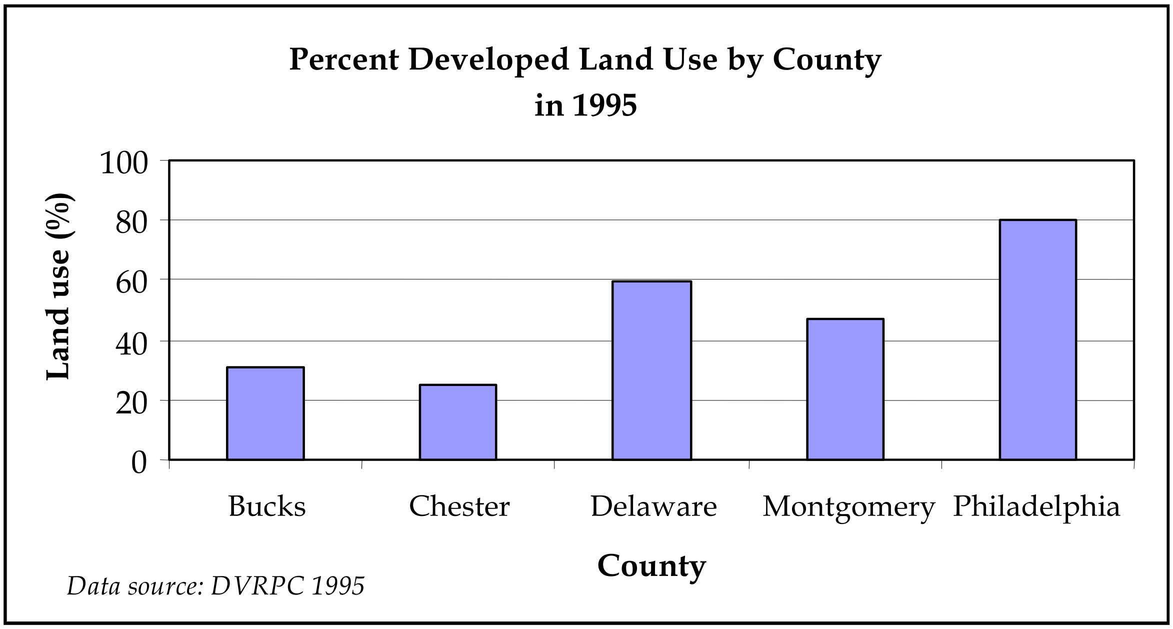
Figure 2.3.1-4 Change in Land Use in the Schuylkill Watershed
Data is from the National Resources Inventory, 2001. Error bars indicate 95% confidence intervals for data in broad land use categories. Agricultural land includes all pasture, grazing and croplands. Developed land includes all urban land and rural transportation lands.



DVRPC Land Use Data Set

The DVRPC data includes five of Schuylkill watershed's 11 counties (Bucks, Chester, Delaware, Montgomery, and Philadelphia). Figure 2.3.1-5 provides a breakdown of the developed land use in 1995 for those counties, based upon the DVRPC data set.

Figure 2.3.1-5 Percent of Developed Land Use by County in 1995



The DVRPC data was supplemented with information collected from Berks County Planning Commission to show development trends in the counties. As shown in Figures 2.3.1-6 and 2.3.1-7, Philadelphia and Delaware Counties have been significantly developed, have reached their development limits, and have observed decreases in their populations over the past two decades. Residents leaving the densely developed areas are suspected to have moved to nearby counties that are less developed, thus starting the cycle of suburban sprawl. The developed land area and population in Montgomery County continue to increase, making it first in total developed land area and second in population in the six county region. Twenty-five to thirty-five percent of Bucks, Chester, and Berks counties are developed, but due to the large size of these counties, they have nearly the same amount of total developed land area in square miles as Montgomery County.

Figure 2.3.1-6 Percentage of Developed Land Area by County

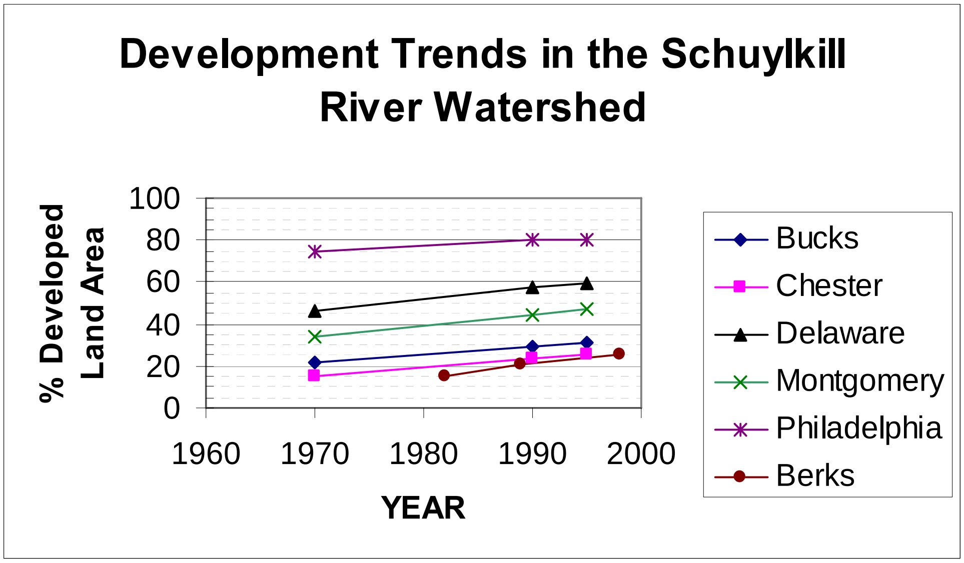


Figure 2.3.1-7 Changes in Developed Land Area by County (in sq. miles)

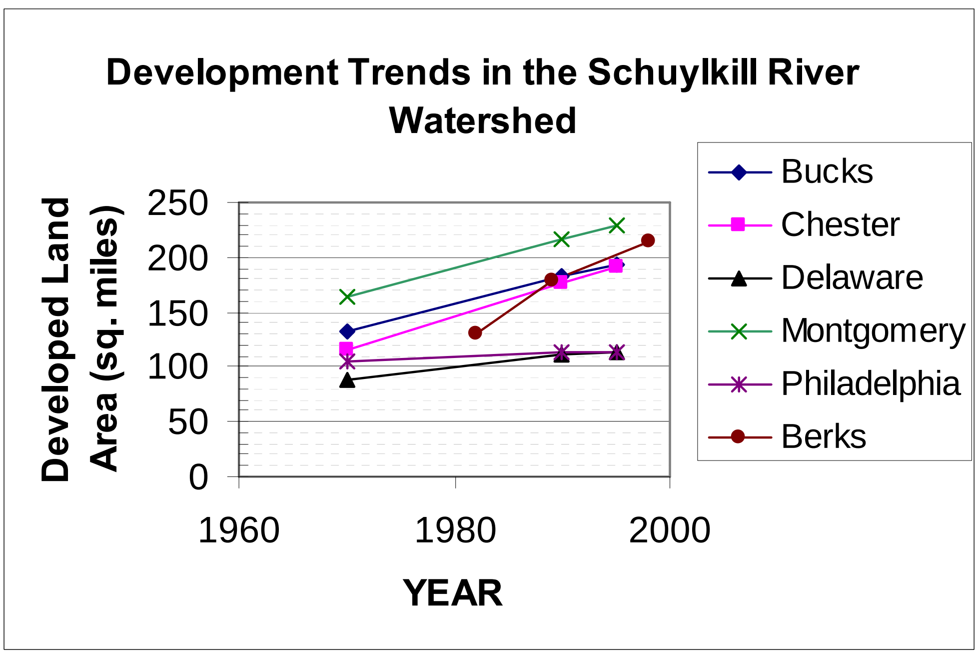
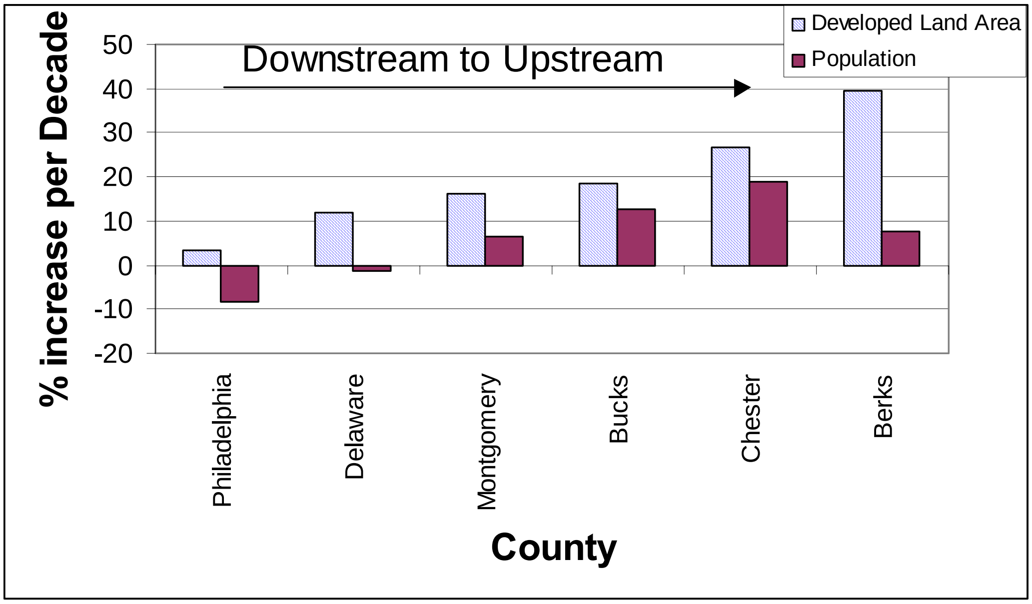


Figure 2.3.1-8 shows that population and developed land area have been increasing significantly since 1970 in the suburban areas of the watershed, as development expands from the city to the suburbs and beyond. These trends also show that the most significant changes are occurring in Berks, Chester, and Montgomery counties, which comprise approximately 70% of the land area in the Schuylkill River watershed.

Figure 2.3.1-8 Percent Change in Developed Land and Population from 1970 to 2000 by County in the Philadelphia Region



Modified Land Use Methodology for the USGS Dataset

To further characterize the Schuylkill watershed, the National Land Cover Dataset (NLCD) was obtained from the USGS website, http://edc.usgs.gov/products/landcover.html. The NLCD is a 21-class land cover classification and is based on the USGS early-mid 1990's 30-meter Landsat thematic mapper (TM) supplemented with additional data analysis and interpretation of the Landsat data. The Schuylkill watershed includes 14 of the 21 NLCD land cover categories: high and low intensity residential, agricultural pasture/hay and row crops, commercial/industrial/transportation, deciduous forested, evergreen forested, mixed forested, open water, quarries/strip mines/gravel pits, transitional, urban/recreational grasses, emergent herbaceous wetlands, and woody wetlands.

Reliable characterization of land use within the watershed is important for the source water assessment and protection process, as it is the basis for estimating non-point source loadings. The USGS data set was used as the basis for the land use characterization in the Schuylkill River watershed because it is believed to be the most accurate characterization available.

The existing land cover dataset was updated with 2000 Census data populations to account for increases in residential development since the land cover data was developed. The 2000 Census population was intersected with the land cover dataset in ArcInfo GIS. The 2000 Census population intersection with the NLCD data identified residential development in areas characterized as agriculture and open space (e.g. wooded and forested) in the NLCD coverage. In these areas, the land cover designations were modified to high or low intensity residential to reflect the growth in population and as a result, the increase in residential areas. This new coverage containing the intersected NLCD land cover and the 2000 Census population data became the current or existing "land use" coverage discussed in this protection plan and was used as the basis to complete the build out scenario.

Figure 2.3.1-9 shows the population change by major watershed as well as the entire Schuylkill watershed from 1990 to 2000, according to census data. The greatest increase is seen in the Perkiomen Creek watershed. A decrease in population in the Lower Schuylkill watershed, which includes more urban and developed areas such as Philadelphia and Montgomery counties, reflects the influence of suburban sprawl, as people move out into the surrounding suburban counties. Table 2.3.1-2 lists municipalities with an increase in population of more than 1,000 persons between 1990 and 2000. Figure 2.3.1-10 shows the percent change in population throughout the watershed and by municipality. Limerick and Upper Providence Township had the highest increase with a total of 12,491 new residents in these two municipalities alone.

Figure 2.3.1-9 Population Change from 1990 to 2000 by Major Watershed

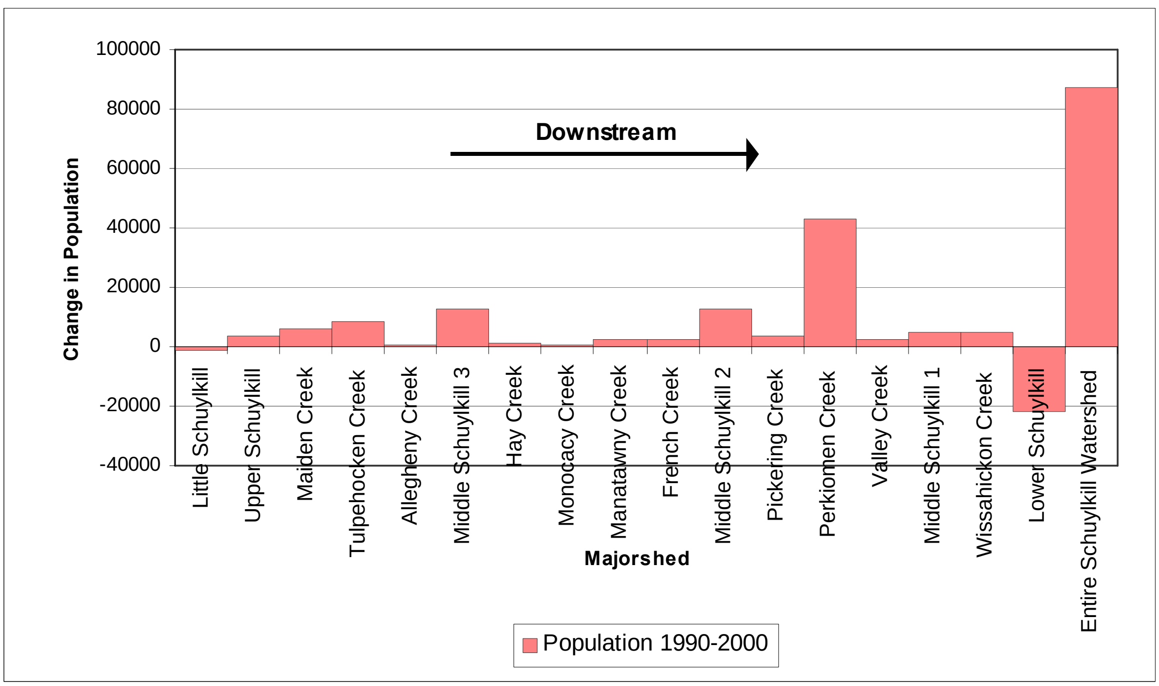
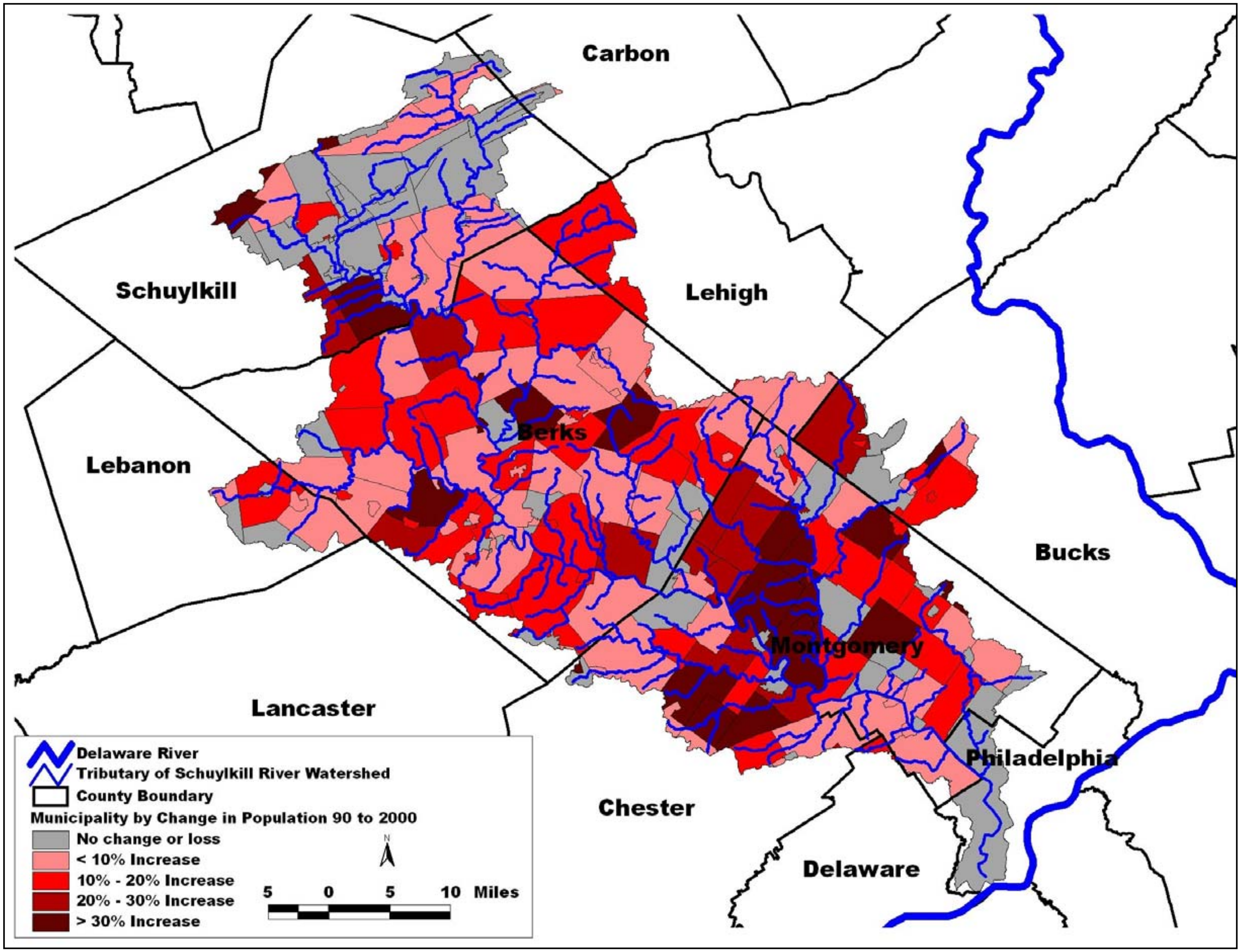


Table 2.3.1-2 Municipalities with an Increase in Population of at Least 1,000 Persons (1990-2000)

Municipality	County	Acres	Population 2000	Population 1990	Change in Population	(%) Change
Limerick	Montgomery	14,579	12,837	5,985	6,852	53%
Upper Providence	Montgomery	11,653	14,772	9,133	5,639	38%
Perkiomen	Montgomery	3,171	6,918	2,965	3,953	57%
Franconia	Montgomery	8,738	10,331	6,454	3,877	38%
Collegeville	Montgomery	1,035	8,045	4,174	3,871	48%
Exeter	Berks	15,730	20,232	16,442	3,790	19%
Towamencin	Montgomery	6,204	17,255	13,923	3,332	19%
Maidencreek	Berks	9,155	6,260	3,160	3,100	50%
Worcester	Montgomery	10,388	7,073	3,990	3,083	44%
Lower Providence	Montgomery	9,949	21,968	18,953	3,015	14%
Spring	Berks	8,023	20,118	17,290	2,828	14%
Reading	Berks	6,437	81,012	78,194	2,818	3%
Whitpain	Montgomery	8,279	18,029	15,304	2,725	15%
Lower Pottsgrove	Montgomery	5,127	11,017	8,584	2,433	22%
Amity	Berks	11,780	8,303	5,911	2,392	29%
Muhlenberg	Berks	7,567	14,587	12,286	2,301	16%
Lower Salford	Montgomery	9,257	12,382	10,159	2,223	18%
Douglass	Montgomery	9,824	8,705	6,630	2,075	24%
Upper Gwynedd	Montgomery	5,213	13,962	11,958	2,004	14%
Lower Heidelberg	Berks	9,911	3,880	1,959	1,921	50%
Whitemarsh	Montgomery	9,411	16,193	14,477	1,716	11%
Milford	Bucks	17,469	7,503	5,994	1,509	20%
Upper Dublin	Montgomery	7,681	22,500	21,007	1,493	7%
Hilltown	Bucks	11,559	8,634	7,183	1,451	17%
Lower Frederick	Montgomery	5,204	4,547	3,118	1,429	31%
Lower Merion	Montgomery	12,820	38,616	37,190	1,426	4%
New Hanover	Montgomery	13,839	6,707	5,293	1,414	21%
Schuylkill	Chester	0	6,669	5,287	1,382	21%
Tredyffrin	Chester	11,959	24,367	23,006	1,361	6%
Montgomery	Montgomery	711	2,939	1,597	1,342	46%
Wyomissing	Berks	2,461	8,555	7,242	1,313	15%
East Vincent	Chester	8,758	5,060	3,763	1,297	26%
Charlestown	Chester	7,983	3,683	2,438	1,245	34%
West Pikeland	Chester	6,391	3,176	2,005	1,171	37%
Trappe	Montgomery	1,329	3,114	1,977	1,137	37%
Upper Merion	Montgomery	11,026	26,362	25,250	1,112	4%
Rockland	Berks	10,919	3,349	2,307	1,042	31%

Figure 2.3.1-10 Changes in Population by Municipality in Schuylkill River Watershed



Increased commercial areas are associated with increased residential development. To incorporate the commercial development, a ratio of acreage of commercial area per person was calculated based upon the 1990 Census populations. The differences between the 1990 and 2000 Census populations were compiled for each subwatershed. These differences were used along with the estimates of commercial area per person to estimate the changes in commercial area within each subwatershed.

Figures 2.3.1-11 and 2.3.1-12 display the results of the updating methodology applied to the NLCD land use coverage. Decreases in agricultural and forested areas result from increases in development (i.e., residential and commercial/industrial/transportation). After systematically modifying the USGS' NLCD data set, originating in the early-mid 1990's, an increase in developed area of almost 30,000 acres, or over two percent, was identified in the Schuylkill watershed. Residential land development generally increased in the downstream reaches of the Schuylkill watershed, especially in the larger subwatersheds.

Figure 2.3.1-11 Change in Developed Areas (Conversion from NLCD Dataset to NLCD Dataset with 2000 Population)

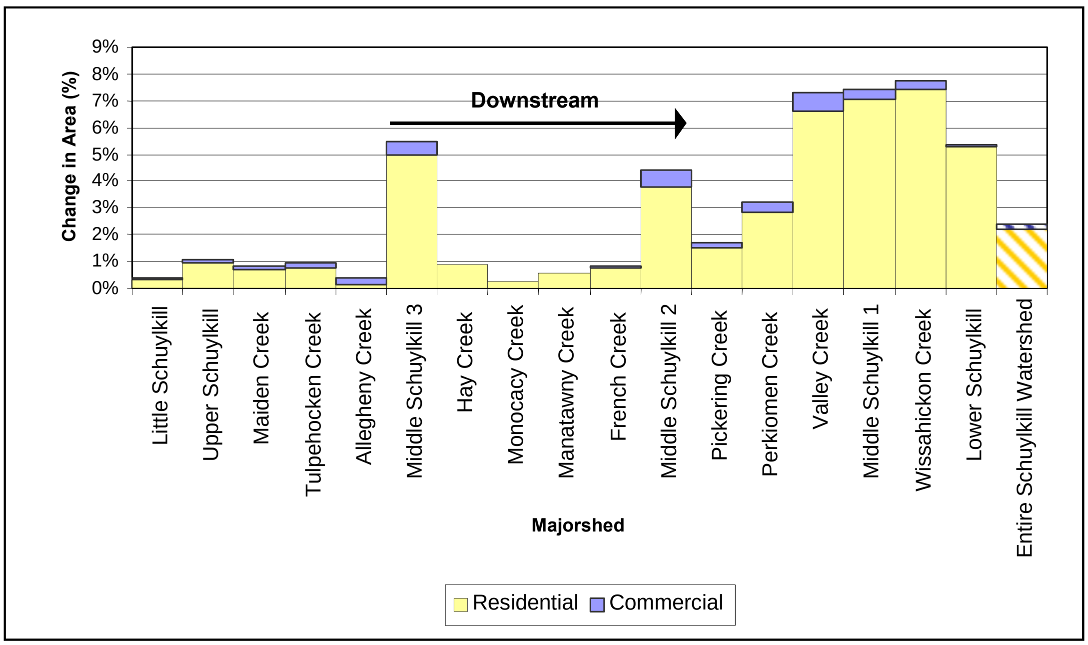


Figure 2.3.1-12 Change in Agricultural and Forested Areas (Conversion from NLCD Dataset to NLCD Dataset with 2000 Population)

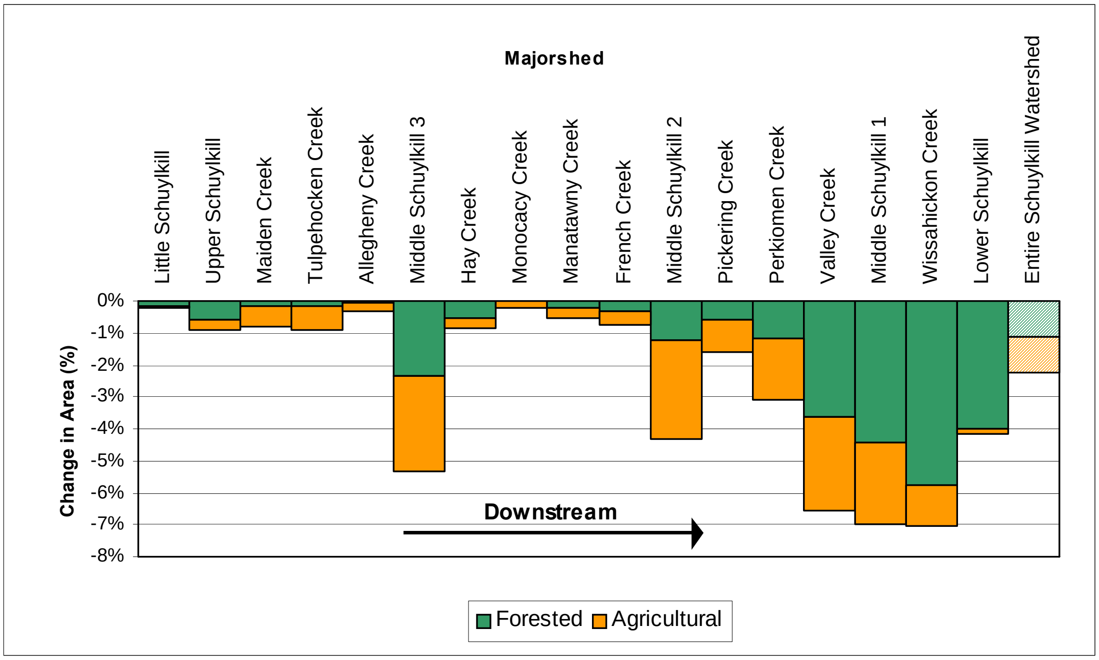


Table 2.3.1-3 summarizes the land use characterization for the Schuylkill River watershed area and reflects modifications in residential development and increases in commercial areas. More than 83% of the Schuylkill watershed is characterized as agriculture, forests, and wetlands. Developed and urbanized areas account for about 14% of the entire area.

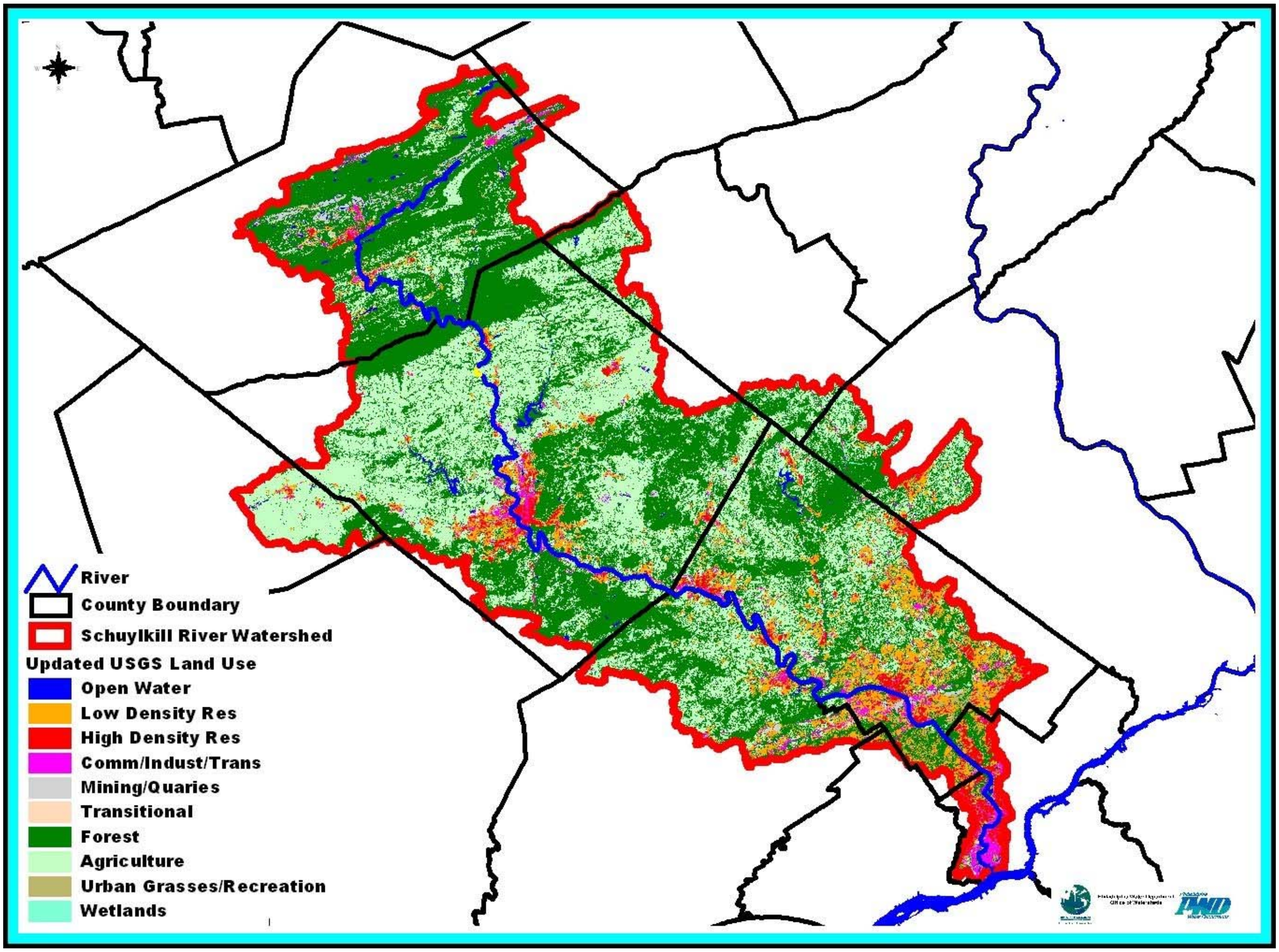
Table 2.3.1-3 Updated Land Use Categories

Land Use Category	Subcategory	Area (acres)	Percentage of Schuylkill Watershed Area
Agricultural	Pasture/Hay	357285	29.1%
	Row Crops	86891	7.1%
Commercial/Industrial/Transportation		35633	2.9%
Forested	Deciduous Forest	481255	39.3%
	Evergreen Forest	37569	3.1%
	Mixed Forest	52414	4.3%
Open Water		15118	1.2%
Quarries/Strip Mines/Gravel Pits		13707	1.1%
Residential	High Intensity Residential	36024	2.9%
	Low Intensity Residential	90686	7.4%
Transitional		4083	0.3%
Urban/Recreational Grasses		7427	0.6%
Wetlands	Emergent Herbaceous Wetlands	4276	0.3%
	Woody Wetlands	3738	0.3%

While this land use characterization is believed to provide the most accurate and up-to-date coverage of land use in the Schuylkill River watershed, it results in a lower estimate of developed land than the USDA and DVRPC characterizations. Nevertheless, all three land use characterizations demonstrate a consistent trend of increased development within the watershed. Development of a current land use map of the entire Schuylkill River watershed would be most useful in establishing current levels of developed land area within the watershed.

Figure 2.3.1-13 shows the updated NLCD coverage but does not reflect new commercial development since those areas cannot be spatially represented. As shown in Figure 2.3.1-13, the most developed areas tend to be aggregated at the bottom of the watershed, follow major transportation corridors, or are located near Philadelphia, Norristown, Pottstown, and Reading. The majority of agricultural lands are located in the middle and upper part of the watershed in Berks and Chester counties. The majority of forested lands are located in the upper portion of the watershed in Berks and Schuylkill Counties.

Figure 2.3.1-13 Updated Land Use in the Schuylkill River Watershed



2.4. Schuylkill Watershed Land Use/Land Cover Build Out Model

Changing land use characteristics within a watershed can have a profound impact on both water quantity and quality. Without proper controls and preventative practices, the "health" of a watershed can deteriorate through unwanted side effects such as habitat destruction, erosion, and sedimentation caused by increased runoff volumes and peak flows, and decreased water quality conditions resulting from pollutant build up on the land surface. While evaluating the existing land use/land cover of a watershed provides a snapshot in time of current stormwater related issues, only an analysis of potential future scenarios can provide the information necessary to make land use planning decisions and to pick the appropriate preventative practices that will protect or improve the "health" of a watershed undergoing development.

A land use/land cover build out scenario was developed and simulated using the U.S. EPA's Stormwater Management Model (SWMM) to estimate potential changes in runoff pollutant loads throughout the watershed. The build out scenario was assembled mostly using available zoning data obtained on the county level. Development restrictions such as delineated wetlands, preserved open space, and steep slopes were considered in creating the build out scenario. Where zoning was available, the remaining lands were developed to the maximum capacity provided in the zoning regulations. When zoning was not available, a rural low density residential development was assumed for available open space.

The calibrated model of existing conditions developed for the Schuylkill SWAP was updated to reflect the build out scenario land use/land cover conditions. The build out model was developed using the same assumptions that were used for the existing conditions model so that it would be reasonable to compare results.

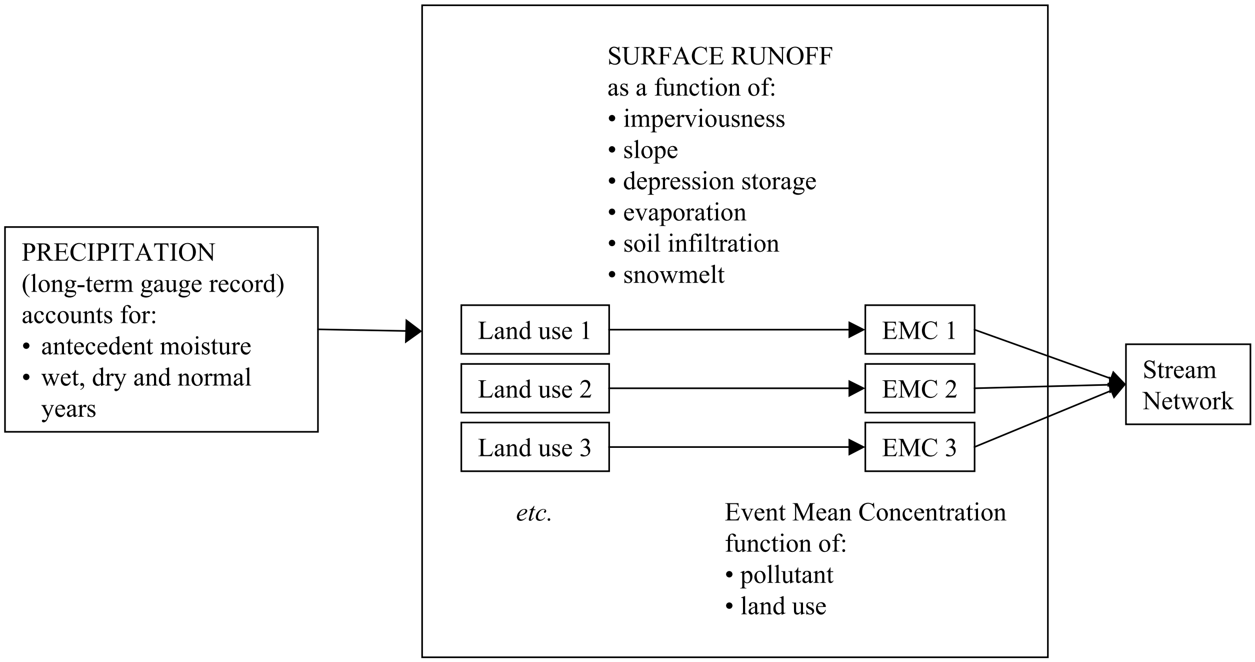
2.4.1 Build Out Model Development

Method

The RUNOFF Module of SWMM simulates rainfall-runoff quantities and quality at specified inlet locations. Figure 2.4.1-1 displays the structure of the SWMM RUNOFF Module. The model uses information, by subshed, on rainfall time-series, climatic data, and event mean concentrations (EMCs) for each of the land use categories, and produces annual and monthly pollutant loads for the length of the simulation period. The model incorporates infiltration, depression storage, and roughness to estimate runoff flow and ultimately, runoff pollutant quantities.

The amount of a particular pollutant reaching the receiving stream is dependent on the volume of surface runoff and the concentration of that constituent in the runoff. An EMC is the total mass load of a pollutant yielded from a site during a storm divided by the total runoff water volume discharged during the storm. EMCs are related to the constituent of interest and the land use type. For a subshed, the surface runoff from a particular land use predicted by SWMM RUNOFF, is multiplied by the EMC for that land use type to yield a loading rate.

Figure 2.4.1-1 Watershed Loading Model Schematic Diagram



Subcatchments

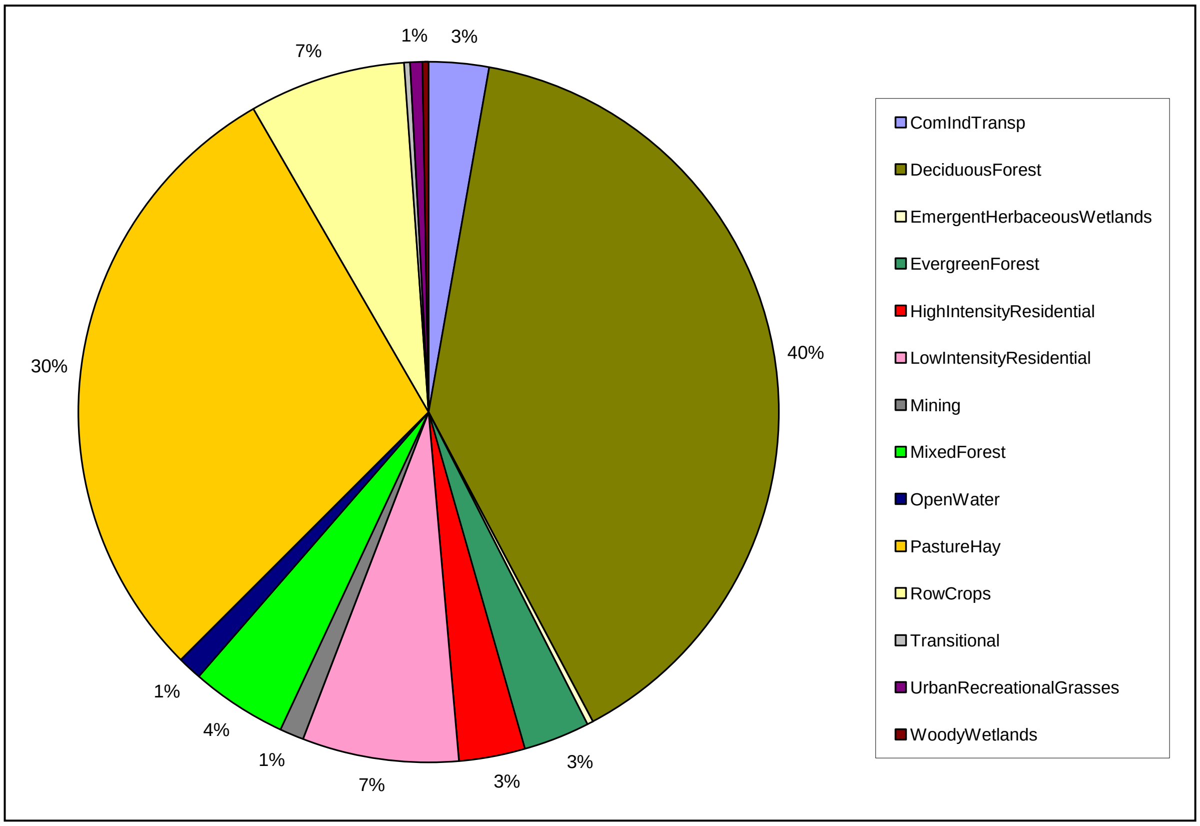
The subcatchments of the Schuylkill River watershed ultimately drain into the Delaware River. The Schuylkill watershed is composed of 356 subwatersheds at the Hydrologic Unit Code (HUC) 14 level. The subwatersheds at the HUC 14 level were further divided into land use categories to track the contributing pollutant loads from each land use category. The land use categories used to simulate build out conditions were identical to those used for the existing conditions simulation. The land use classifications were changed when appropriate using available zoning information. Environmental restrictions such as designated wetlands and steep slopes were considered restrictions to changing a land use designation between existing and build out conditions. When zoning information could not be obtained, environmental restrictions were used to remove “undevelopable” lands. The remaining agricultural, forested, and open lands were converted to low density residential.

The land use categories influence the amount of rainfall that runs off the surface of the subwatershed, as opposed to infiltrating into the subsurface or entering the atmosphere through evapotranspiration. For example, during a storm, more rainfall runs off from a residential area than from a forested area, since there are more impervious surfaces such as driveways, roads, and buildings in developed areas. The forested area retains more of the rainfall, which either infiltrates into the ground or evaporates. For modeling purposes, the land use categories were summed for each subwatershed in order to track individual land use loading contributions to the totals for each subwatershed.

2.4.2 Existing Conditions

Land use within the Schuylkill watershed varies from heavily urbanized to agricultural to undeveloped. The southeast portion of the watershed, in and around the City of Philadelphia, generally consists of high density residential land use along with commercial and industrial uses. The southern portions of Montgomery County are more suburban and transition into agricultural land use and forested land cover. The remainder of the watershed is almost entirely agricultural and forested with the exception of some smaller urban centers. Figure 2.4.2-1 shows that approximately half of the watershed is classified as forest, 37% as agricultural, and 10% as residential. The remaining land use/land cover classifications do not make up a significant portion of the watershed.

Figure 2.4.2-1 Model Land Use Distributions of Existing Conditions

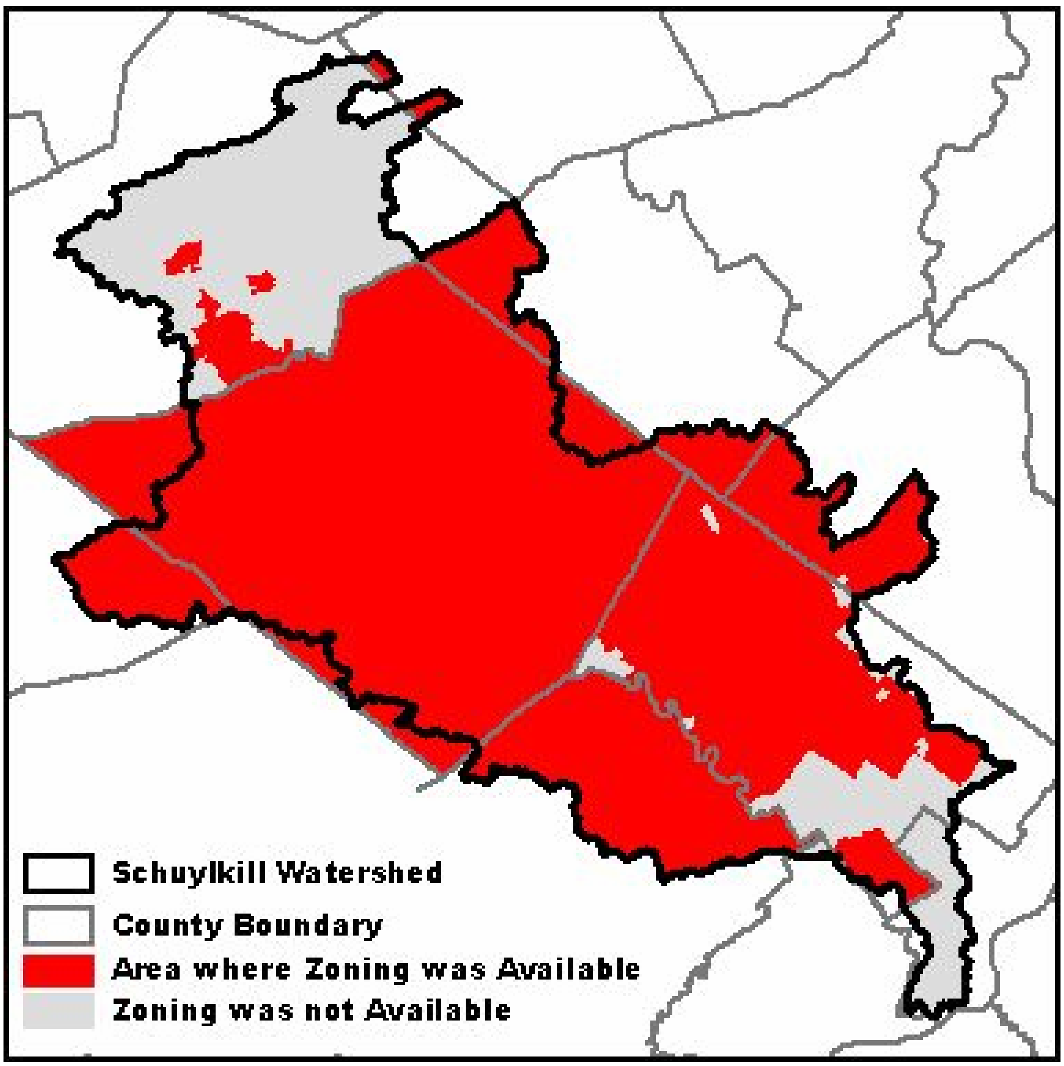


2.4.3 Build Out Conditions

The build out scenario indicates the potential for a significant change in the land use/land cover within the Schuylkill watershed. The scenario is based on zoning information for most of the watershed. Zoning information was not available for all areas of the watershed. For those areas where zoning data were available, it was assumed that all areas were fully developed according to the zoning assigned. There are more than 400 different zoning descriptions that, for the build out analysis, were paired down into the land uses to match the existing conditions. All information available from zoning maps or ordinances available online was used to come up with a percent impervious for each of the zoning descriptions listed. The zoning descriptions vary; for example, sometimes a maximum lot coverage is allowed, a minimum lot size, or number of housing units allowed per acre to name a few.

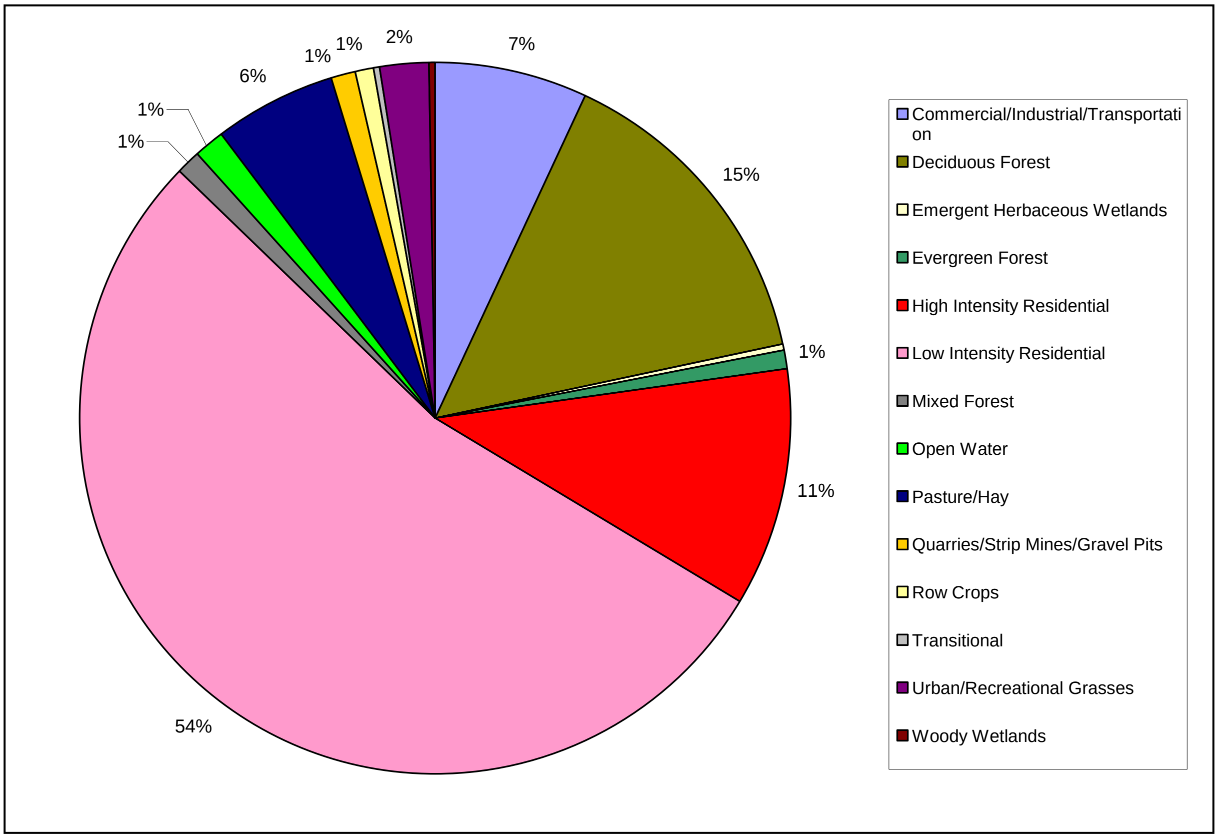
Figure 2.4.3-1 shows the "no data" areas compared with areas where data were available. Zoning data was available for approximately 79%of the Schuylkill River watershed. For areas without zoning, it was assumed that agricultural, forested, and vacant lands that were not environmentally constrained (steep slopes, listed wetlands) were all available for residential development. A low density residential housing classification was then applied to all available lands to create full build out. No commercial or industrial land was added to these areas, however.

Figure 2.4.3-1 Zoning Data Availability



The land use distribution of the build out scenario is shown in Figure 2.4.3-2. Under current zoning, low density residential development could increase drastically as agricultural and forested lands are developed. It should be noted that the approach used to perform the build out scenario in areas where zoning data were not available will tend to overestimate development, because all developable agricultural and forested lands were assumed to convert to low density residential in the absence of zoning guidelines. The scenario also predicts a drastic increase in the percentage of developed areas, because zoning would allow the high density residential classification to more than triple and commercial/industrial/transportation to more than double. These land use classifications typically have the greatest impact on watersheds since high impervious cover and pollution are associated with them.

Figure 2.4.3-2 Model Land Use Distribution of Build Out Conditions



Impervious Cover

For existing conditions, the percentage of impervious cover in developed land areas was calculated in relation to population density by using the Stankowski method. The formula is:

$$I = 0.117D^{0.792-0.039\log D}$$

I =impervious area in square feet, D = population density in people per square mile

For the build out scenario, impervious cover was determined based upon three methods. The method used depended upon the zoning information available for the municipalities in the watershed.

1. *GIS zoning coverage available* - Zoning descriptions were obtained from the county offices and matched up with the National Land Cover Dataset (NLCD) land use descriptions. The NLCD land uses assigned were then matched up to similar land uses in the existing conditions analysis and a percentage of impervious cover was assigned.

2. *Paper zoning maps available* – The maps were geo-referenced using GIS. The zoning descriptions were obtained from either the maps themselves or from the zoning ordinances. Each zoning description was matched with a NLCD land use. The average percentage of impervious cover by county, based upon the existing conditions, was then assigned to the build out scenario.

3. *Zoning information unavailable* – Existing agricultural and forested lands that were not considered environmentally constrained (high sloped areas or wetlands) were assigned an impervious cover value of 4.3%. This value represents the Stankowski impervious cover estimate for three people per acre, which was considered low density development for these areas.

Using these methods, the amount of impervious cover within the Schuylkill River watershed is estimated to increase by approximately 8% to a total of approximately 18% at full build out. One of the primary indicators of watershed "health" is the percent of impervious cover in the watershed. Based on numerous research efforts, studies, and observations, a general categorization of watersheds has been widely applied to watershed management based on percent impervious cover (Schueler 1995). These categorizations are summarized in Table 2.4.3-1.

Table 2.4.3-1 Watershed Characterizations

Characteristic	Sensitive	Degrading	Non-Supporting
Percent Impervious Cover	0% to 10%	11% to 25%	26% to 100%
Channel Stability	Stable	Unstable	Highly Unstable
Water Quality	Good to Excellent	Fair to Good	Fair to Poor
Stream Biodiversity	Good to Excellent	Fair to Good	Poor
Pollutants of Concern	Sediment and temperature only	Also nutrients and metals	Also bacteria

According to this information, an increase in impervious cover from 10% to 18% as predicted by the build out analysis could result in increased channel erosion, reduced water quality, and decreased stream biodiversity.

2.4.4 Event Mean Concentrations (EMCs)

Applying EMCs to calculated runoff volumes provides reasonable estimates of runoff pollutant loadings. EMCs for the soluble pollutant categories were assigned according to the land use category. The SWMM RUNOFF Module allows the model to assume a constant concentration of a constituent for the duration of the storm event. The quantity of a constituent in surface runoff is a function of constant EMCs associated with the land use categories. The RUNOFF model water quality parameters included *Cryptosporidium*, TOC (precursors for disinfection by-products), nitrogen (representing conservative nutrients), phosphorus (representing non-conservative nutrients), turbidity, and total/fecal coliform. For each of these contaminant types, a surrogate constituent was selected. The complete list of EMCs is provided in Table 2.4.4-1.

Table 2.4.4-1 Event Mean Concentrations

Parameter	Cryptosporidium/ Giardia	Disinfection Byproducts	Total/ Fecal Coliform	Conservative Nutrients	Non-Conservative Nutrients	Turbidity
Surrogate	Cryptosporidium	TOC	Fecal Coliform	Nitrogen	Phosphorous	TSS
Land Use	cst/100ml	mg/L	col/100ml	mg/L	mg/L	mg/L
Commercial/Industrial/Transportation	0.6	20	30000	2.39	0.31499	78.4
Deciduous Forest	0.00999	5	10	0.5	0.1	40
Emergent Herbaceous \Wetlands	0.00999	5	10	0.5	0.1	30
Evergreen Forest	0.00999	5	10	0.5	0.1	40
High Intensity Residential	0.6	14	30000	2.39	0.31499	78.4
Low Intensity Residential	0.3	10	30000	2.39	0.31499	78.4
Mining	0.00999	5	10	1.73	0.12899	78.4
Mixed Forest	0.00999	5	10	0.5	0.1	40
Open Water	0.00999	1E-05	5	1.022	0.01999	1
Agricultural - Pasture Hay	1	5	100	2	0.5	500
Agricultural - RowCrops	0.1	5	10	8	1.5	500
Transitional	0.1	5	10	2.39	0.1	2000
Urban Recreational Grasses	0.00999	5	10	2.39	0.31499	78.4
Woody Wetlands	0.00999	5	10	0.5	0.1	30

Runoff volumes are computed for each land use category based on percent imperviousness of the land use, annual rainfall, slope of the subwatershed, evaporation, infiltration, and depression storage. This analysis was performed on a subwatershed-by- subwatershed basis and the results were used to determine load distributions according to the land use category. The pollutant mass load estimate is computed for each land use within each subwatershed as a product of the EMC and the surface runoff. By estimating the pollutant loading over the area of a land use type within a subwatershed and summing for all land uses, the total pollutant load from a subwatershed can be computed.

2.4.5 Meteorological Data

The amount of surface runoff is primarily driven by the precipitation. Long-term climate and precipitation records were used to derive the hydrology of the system. Using a long-term record represents a wide range of hydrologic conditions that occur in a given climate. Using a long-term record on a continuous basis accounts for antecedent moisture conditions and more accurately represents initial conditions at the beginnings of storm events. Snowfall and snowmelt affect the quantity and timing of surface runoff during the winter months and have been included in the long-term continuous simulation.

If available, rainfall, wind, and temperature data for a period of over ten years (1990-2000) were collected for RUNOFF model simulations. The hourly rainfall data were obtained from the National Weather Service (NWS) at stations in and surrounding the Schuylkill River watershed. The hourly data was further discretized into 15-minute increments. To account for snowmelt, the daily minimum and maximum temperatures and average monthly wind speeds were obtained for the period of simulation.

2.4.6 Potential Changes in Pollutant Loading

Potential pollutant loading estimates were obtained by incorporating the build out scenario land use/land cover data into the SWMM model. The model was constructed using the same methodology applied to the existing conditions model. Simulations of the build out scenario were performed using the same meteorological data, EMCs, and simulation period as the existing conditions model. Results of the build out model runs were compared to those obtained during the simulations of existing conditions. The build out results must be understood in the context of the assumptions behind the analysis.

- The build out scenario is predicated partially on existing zoning (where data were available), and partially on the assumption that all available privately owned land would be converted to residential uses where zoning data were lacking.

- The build out scenario is not related to population projections and paints a “worst case scenario” for non-point pollution with regard to population increase.

- The pollutant loads assume that stormwater is being dealt with in much the same way that it has in the past, thus few BMPs to improve water quality. If water quality BMPs were mandated, loading increases could be reduced.

- The pollution increases relate only to non-point pollutant sources. Additional pollutant loads from point sources associated with the build out scenario were not included in the analysis.

Figure 2.4.6-1 shows the estimated percent change in annual pollutant loadings for six contaminant categories. Figures 2.4.6-2 through 2.4.6-7 show the variations in estimated annual loadings throughout the watershed.

Figure 2.4.6-1 Estimated Percent Change in Annual Pollutant Loadings

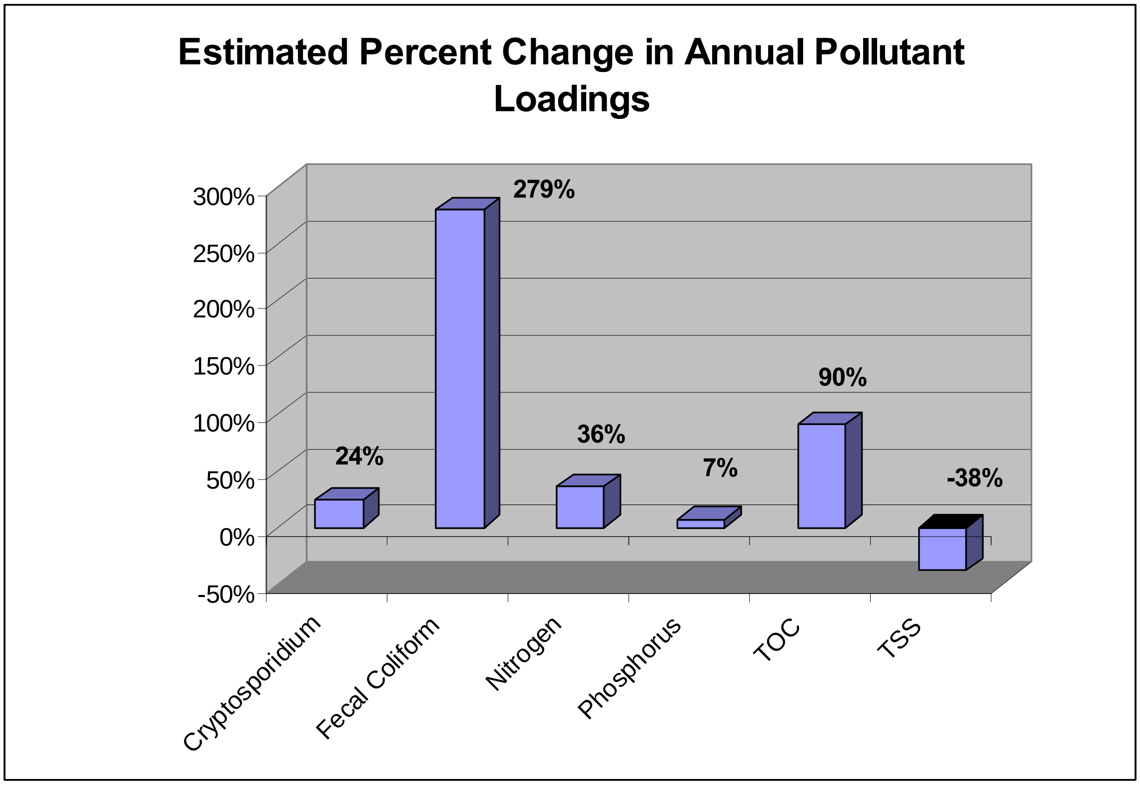


Figure 2.4.6-2 Estimated Change in Annual *Cryptosporidium/Giardia* Loadings

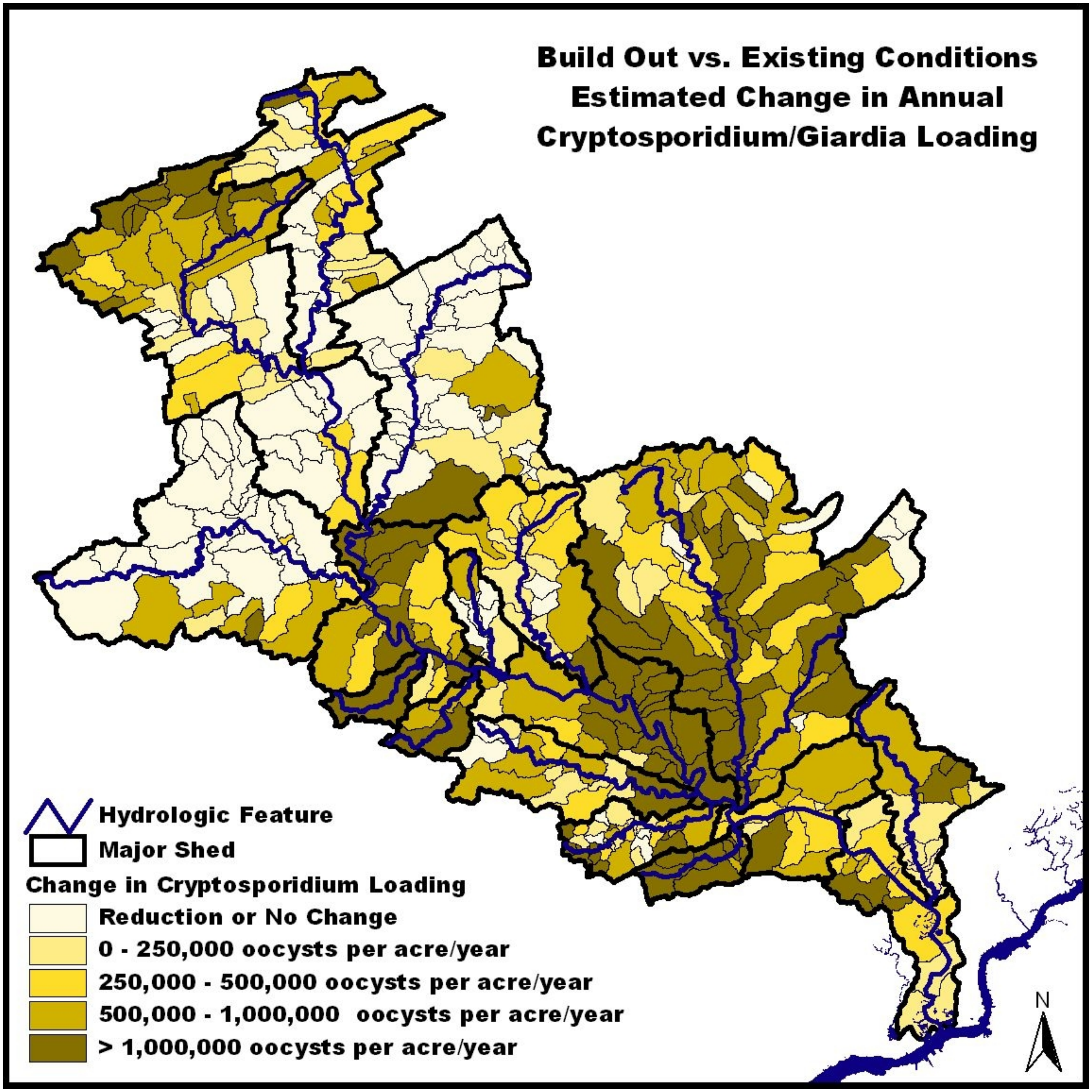


Figure 2.4.6-3 Estimated Change in Annual Total/Fecal Coliform Loadings

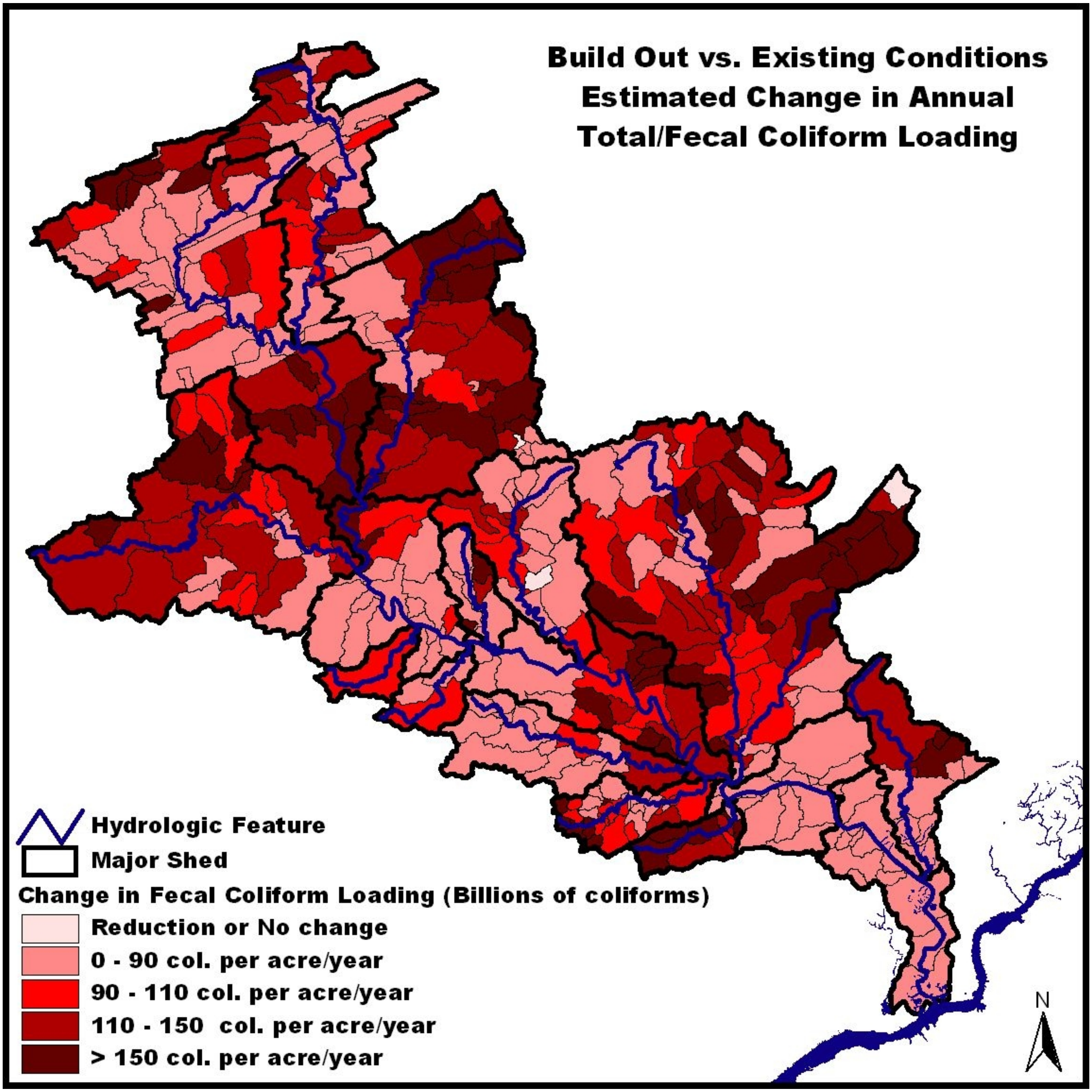


Figure 2.4.6-4 Estimated Change in Annual Conservative Nutrient (Nitrogen) Loadings

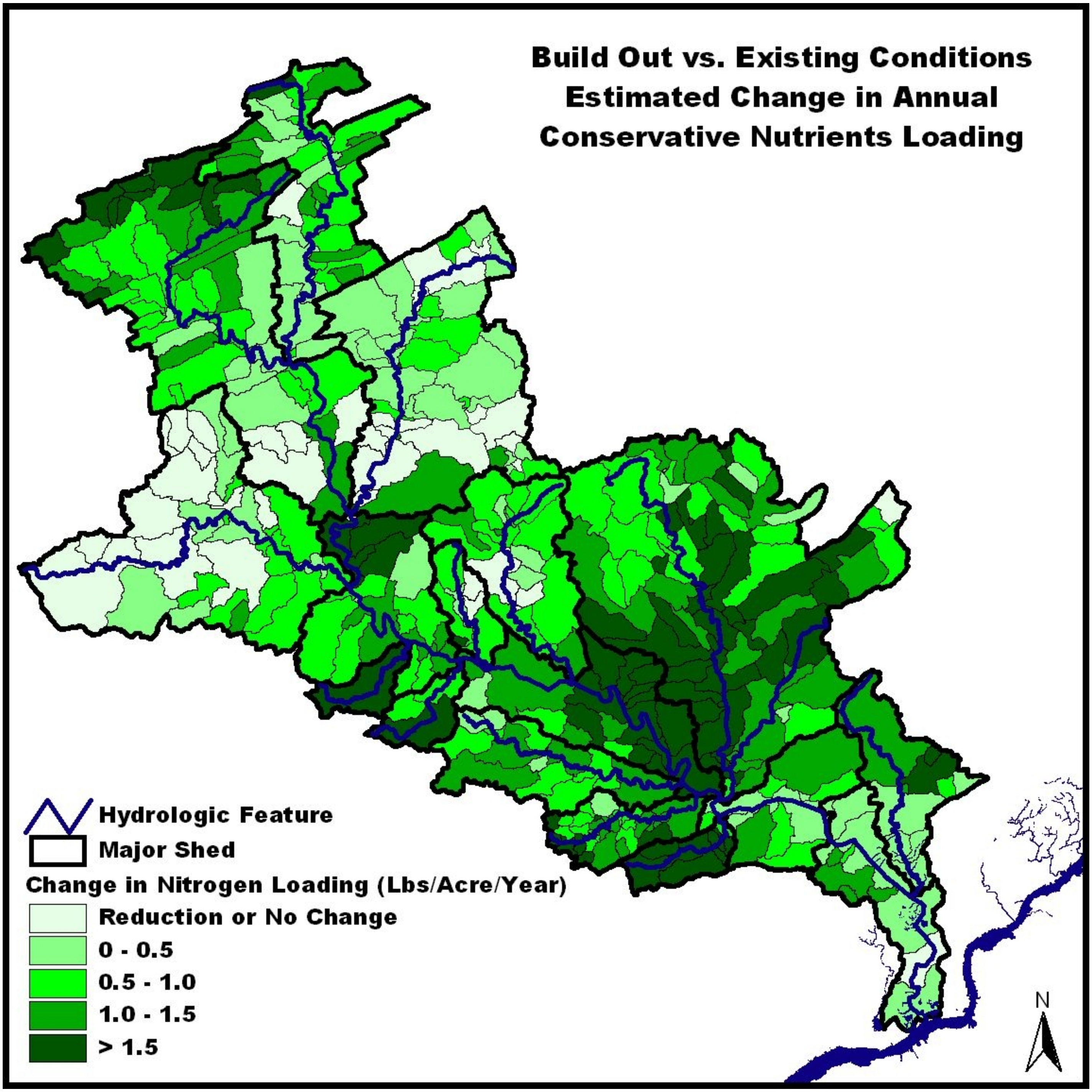


Figure 2.4.6-5 Estimated Change in Annual Non-Conservative Nutrient (Phosphorus) Loadings

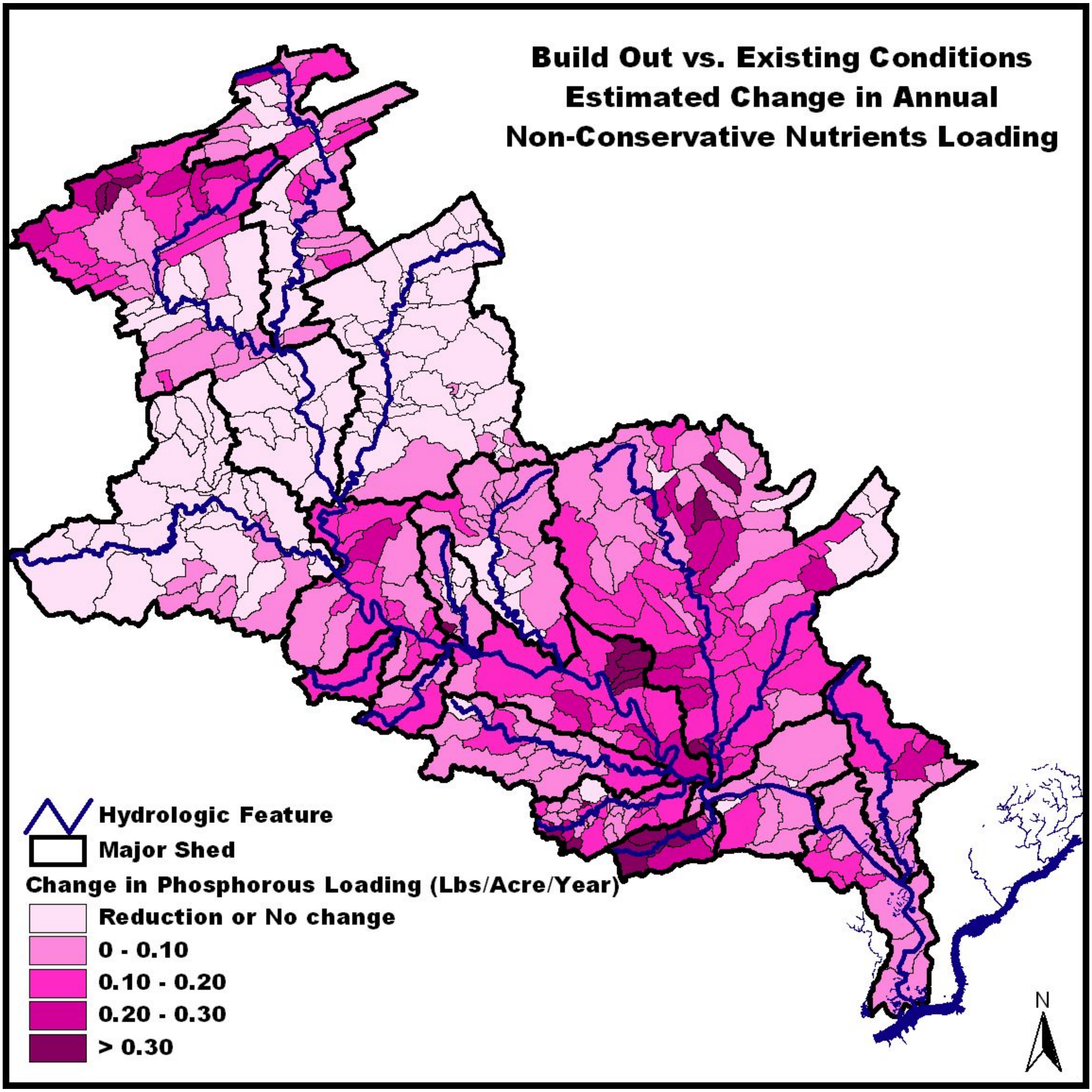


Figure 2.4.6-6 Estimated Change in Annual Disinfection Byproduct (TOC) Loadings

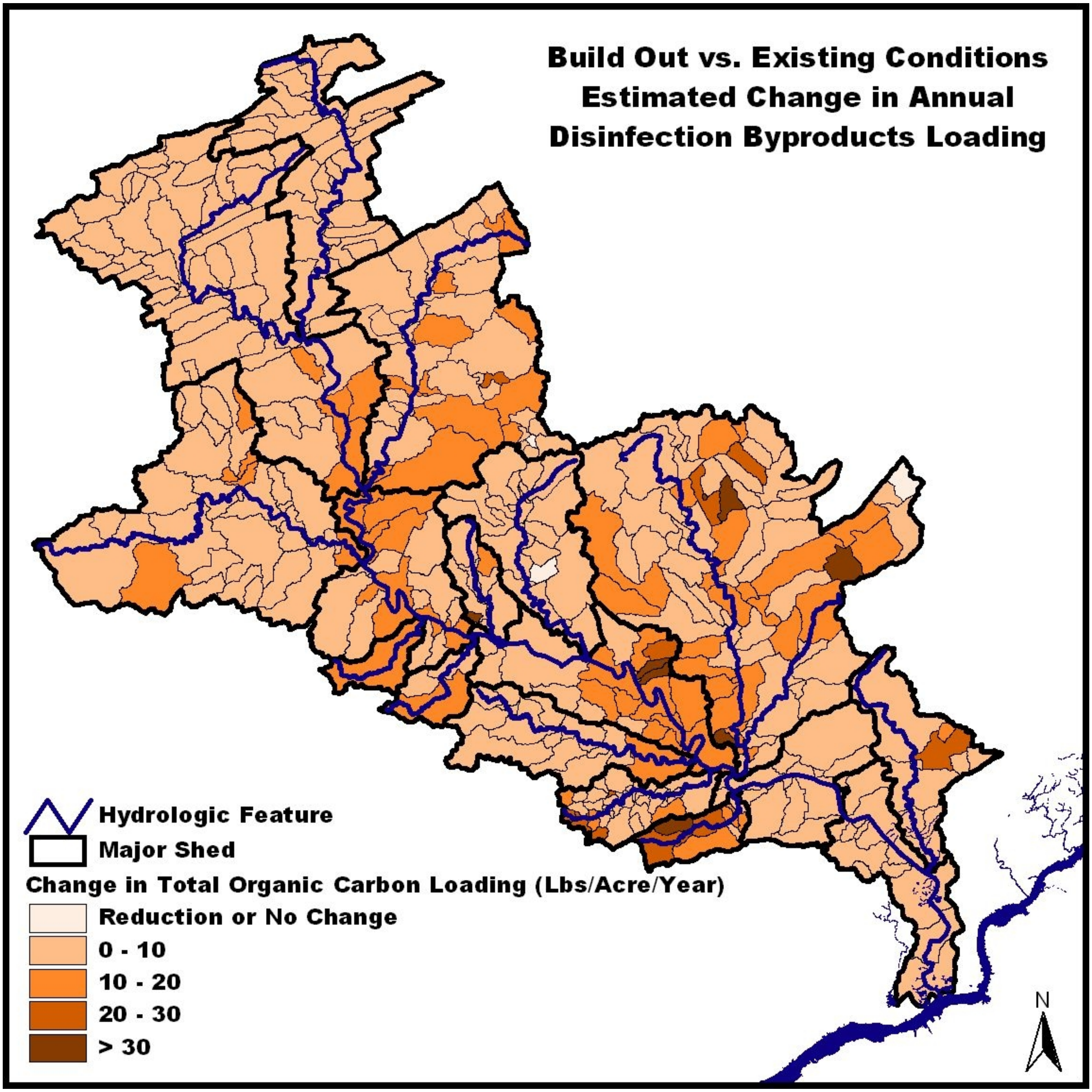
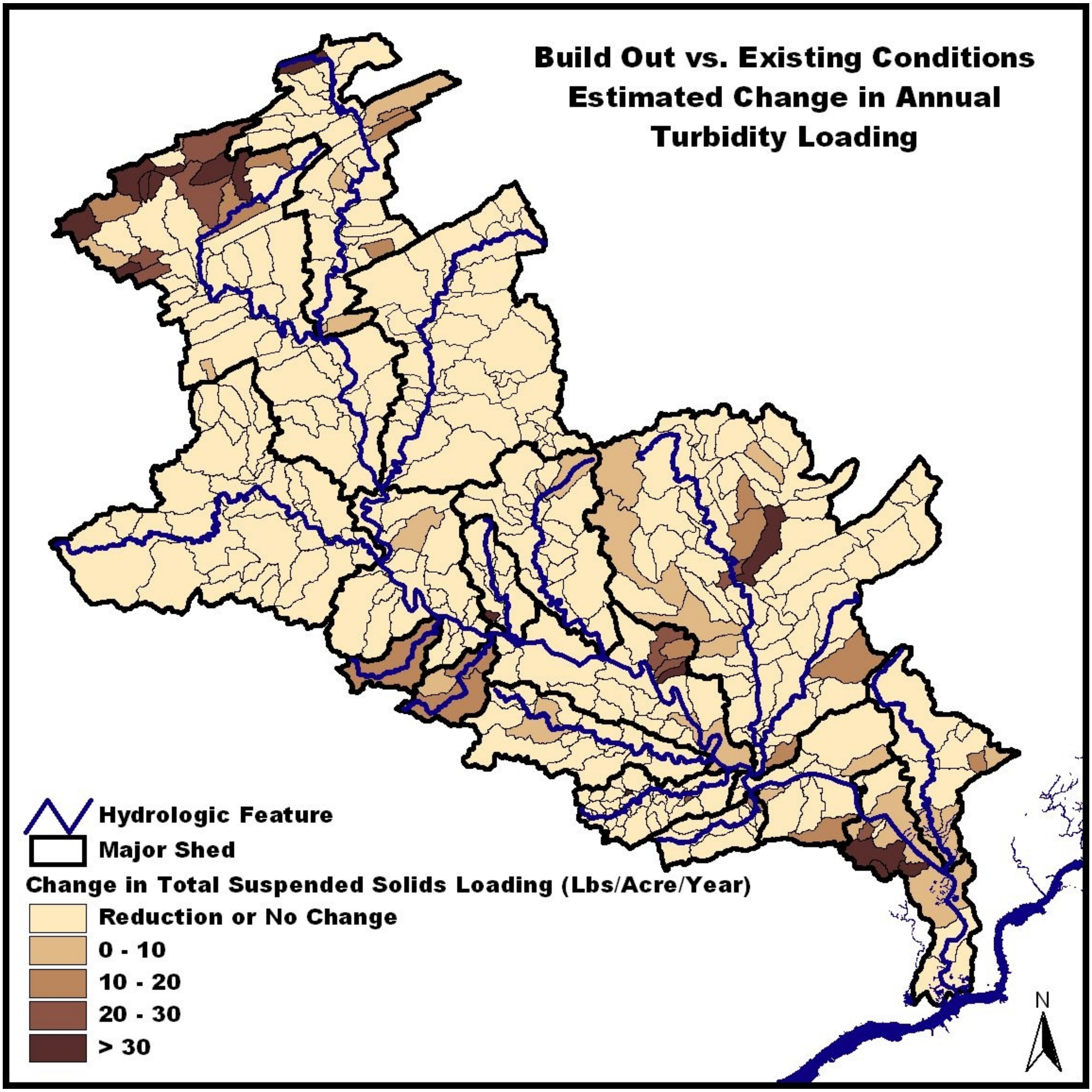


Figure 2.4.6-7 Estimated Change in Annual Turbidity (Total Suspended Solids) Loadings



2.4.7 Build Out Results Summary

For the watershed as a whole, build out would result in the following:

- It is estimated that the watershed is currently about 15% developed. "Developed" is defined as lands used for residential, commercial, industrial, or institutional purposes. At full build out, the percent land developed could reach as high as 68% of all land under current zoning.

- Based on modeling estimates of percent impervious associated with each land use, the watershed has currently about 10 percent of the land surface covered in pavement, roofs, or other impervious surfaces. This places the watershed on the edge of showing impacts to water quantity and water quality due to increased stormwater flows. At full build out, the percent impervious is estimated to increase to about 18%.

- The current population of the entire watershed is estimated to be 1,563,197. At full build out, the population would almost double to about 3,020,197.

It is important to understand that the build out scenario represents a substantial increase in population and housing units within the watershed. Based on rough extrapolations of housing unit trends and population trends from the last decades, it could take anywhere from 50 to 150 years for build out to occur if recent trends continue indefinitely into the future.

2.4.8 Potential Water Quality Impacts at Build Out

Continued development of the Schuylkill River watershed would have a significant impact on water quality if stormwater BMPs are not rigorously implemented. A rough approximation of water quality impacts of stormwater can be made using the modeled increases in the six pollutants where reasonable stormwater concentration data exist. Table 2.4.8-1 shows the estimated increases in pollutant loads from stormwater only, based on a comparison of the SWMM model run for existing conditions and build out conditions.

Table 2.4.8-1 SWMM Stormwater Load Percentage Increases at Build out

Percentage Change in Pollutant Loading at Buildout

Parameter	Flow	Crypto	TOC	Fecal	Lead	Total Nitrogen	Total Phosphorus	Petroleum Hydrocarbons	Salts	TSS
Percent Change	26.2%	23.8%	89.8%	279.3%	235.7%	35.9%	6.6%	238.7%	178.7%	-38.1%

Note that all parameters show a significant increase in stormwater loads with the exception of TSS, which tends to decrease when agricultural land is replaced by low density residential housing. The decrease in TSS carried by stormwater is somewhat misleading. It will be offset by the increase in stormwater flows (26%), which will undoubtedly cause increased instream erosion leading to higher TSS concentrations during storm events at downstream locations.

The estimated 90% increase in Total Organic Carbon (TOC) loading from stormwater is particularly relevant to drinking water intakes because it represents a significant increase in the precursors of disinfectant byproducts, which are already a concern along the river at many of the drinking water intakes. This increase in loading could result in an increase of 1 to 2 mg/l of TOC in the river.

Increased stormwater is only one potential effect of continuing development of the watershed. Assuming that the new development occurs along with the construction of sewage collection and treatment systems, additional point source loads will occur through the discharge of treated wastewater to the river. An estimate of the impact of increased sewage flows can be made using the build out population. Using EPA average concentration data for sewage discharges, the potential increase in concentration due to a doubling of the population is shown in Table 2.4.8-2. The projected increases in BOD and phosphorus are both a concern for dissolved oxygen concentrations in the river, particularly during low flow periods.

Table 2.4.8-2 Sewage Flow Related Impacts at Build out

Projected Sewage Impacts at Buildout									
			sewage per person liters per day	Existing mg/d	Existing mg/l	Buildout mg/d	Buildout mg/l	Increase mg/d	Concentration Increase mg/l (mean annual flow)
BOD	30	mg/l	378	1.77E+10	2.66	3.42E+10	5.14	1.65E+10	2.48
TSS	30	mg/l	378	1.77E+10	2.66	3.42E+10	5.14	1.65E+10	2.48
Lead	0.0006	mg/l	378	3.55E+05	0.00005	6.85E+05	0.00010	3.30E+05	0.00005
Phosphorus	1.6	mg/l	378	9.46E+08	0.14	1.83E+09	0.27	8.81E+08	0.13
TKN	3.95	mg/l	378	2.33E+09	0.35	4.51E+09	0.68	2.17E+09	0.33

2.5 Identification of Universal Water Quality Issues

2.5.1 Introduction to Water Quality

The Schuylkill River is a much healthier river now than it was over the past century, when it was branded as "too thin to cultivate, too thick to drink." The time when the river ran black with culm, smelled of raw sewage, and was covered in sheens of oil or foamed with detergent bubbles is gone. Better water quality has resulted in tremendous improvements in fish, wildlife, and recreational opportunities over the past 20 years. These improvements can be directly related to the following major events:

- The decline of the coal industry;
- The decline in the presence and size of the manufacturing industry (steel, paper mills, textiles, glass, etc) that discharged storm or process water to the river
- The construction of sewers and sewage treatment plants;
- The improvements in sewage and industrial waste treatment plants;
- Improved discharge regulation through the Clean Water Act;
- Regulations limiting the presence of phosphates in detergents; and
- Regulations phasing out the use of certain toxic chemicals.

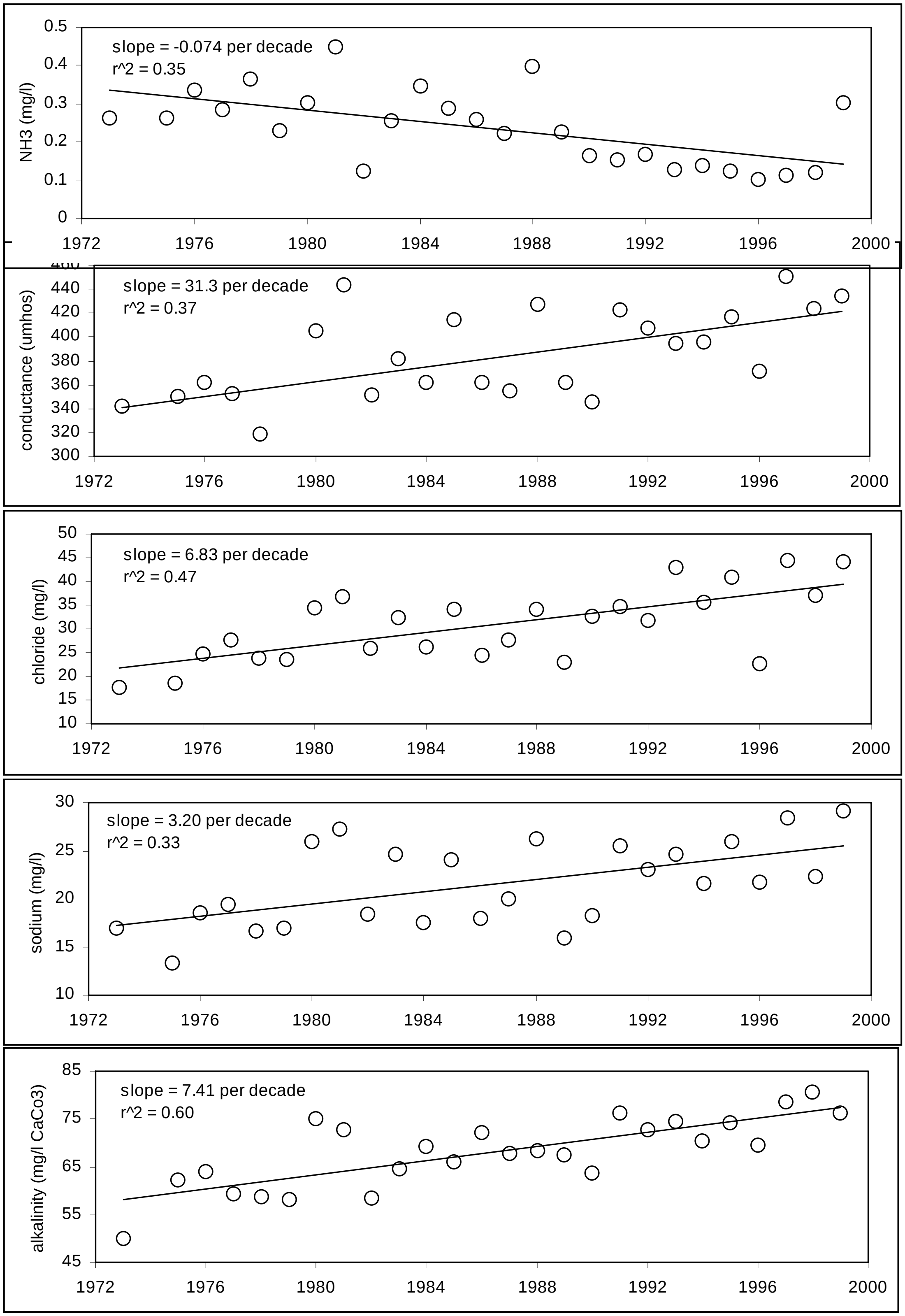
While some of these improvements were related to regulatory initiatives, many changes in water quality were caused by changes in economic and industrial activity within the watershed. The recent improvements in water quality have allowed us to see that in a growing number of areas the main challenges to water quality now come from polluted runoff and not point source discharges. Therefore, the focus of activities that impact water quality are now becoming as much land use related as they are specific point source or facility related.

Assessing changes in water quality over time is very difficult. The data usually are not available to characterize long periods of record for most chemical parameters. If data are available, changes in analytical methods over time can skew results. Data are also often available in some parts of the watershed, but not in others. It is important to note that, based on the above factors; this section can only attempt to examine possible trends in water quality based on available data. Therefore, just because a change is noticed at one location does not mean that it is occurring at all locations. In addition, just because data are not available to characterize an area of the watershed does not mean that the water quality is good or bad.

The general temporal analysis focuses on long-term and past decade trends in water quality in the Schuylkill River at Philadelphia. This site was chosen because it is at the downstream end of the Schuylkill River watershed, had the most significant and extensive monitoring data available, and because it provides evidence of the dominant changes in long term water quality in the watershed as a whole. Ultimately, it is believed that impacts observed at Philadelphia are possibly occurring at a number of locations along the river and throughout its tributaries to some extent. However, this does not mean that every trend observed at Philadelphia may be happening to the same extent, or at all, in other parts of the watershed. It is hoped that as coordination of watershed monitoring is improved to provide appropriate data to describe long-term trends, evaluations at other key locations throughout the watershed can be performed.

Three decades of changes in levels of water quality indicators, such as alkalinity, conductance, chlorides, sodium and ammonia, are summarized in Figure 2.5.1-1.

Figure 2.5.1-1 Changes in Water Quality Indicators in the Schuylkill River at Philadelphia



Analysis of the data yielded the following observations:

- Philadelphia Water Department (PWD) intake data indicate significant increases in dissolved solute concentrations through the 1990s, including elevated levels of sodium, chloride, alkalinity, dissolved solids, and conductivity. These trends appear to extend back through the early 1970s. If they continue, they have the potential to adversely affect drinking water treatment processes for the City of Philadelphia in the future.

- Spatial analysis of conductivity data throughout the watershed indicates that the observed trends are common throughout the watershed.

- If the increasing trends in alkalinity, conductivity, sodium, chloride, bromide, iron, manganese, total organic carbon and turbidity in the river water continue over the next two decades, there will be impacts on water treatment process operation and/or finished water quality. This could result in additional water treatment costs or reduced consumer confidence for many water suppliers in the watershed.

- Increased mass transport levels of sodium and chloride, particularly in winter months through the 1990s, suggest that increased deposition of road salts are significantly impacting water quality at Philadelphia's Schuylkill River drinking water intakes.

- Though this study focused on adverse changes in river water quality parameters, the Schuylkill River has seen significant improvements in important water quality parameters such as dissolved oxygen, ammonia, nitrate, and phosphorous since the 1970s. Schuylkill River nutrient levels (nitrogen and phosphorus measures) have remained stable or decreased over the past decade due to decreased agricultural runoff within the watershed, along with improved wastewater treatment practices. Dissolved oxygen values have been steadily increasing over the past several decades.

2.5.2 Long-Term Water Quality, Historical Trends, and Comparison to Other Rivers

Previous assessments of century-long water quality trends in the Schuylkill River and other northeastern watersheds have demonstrated long term increases in salt concentrations through the 1900s. For instance, nitrate, chloride and total residuals all increased steadily in the Schuylkill River from 1900 through 1970 (see Table 2.5.2-1). These indicators of water quality appeared to level off and remain relatively stable from 1970 through 1990, most likely as a result of improved wastewater treatment and slowing rates of development in the northeastern region (Jaworski and Hetling 1996). Increased national prosperity following the recession of the late 1980s spurred a strong increase in development in suburban regions, including parts of Bucks, Berks, Lehigh, Montgomery, and Chester counties within the Schuylkill watershed. This recent development appears to be causing renewed increases in solute concentrations, driven by increasing wastewater discharge and increased solids transport directly related to land use change.

Recent water quality assessments have indicated long-term temporal increases in nutrient fluxes in major waterways (e. g. Bollinger et al. 1999) in the United States, which may have adverse impacts on water supplies for both drinking water and irrigation systems. These recent trends are apparently driven by major increases in diffuse loading of solutes from both agricultural and urban sources (Novotny and Olem 1994, Reimold 1998). While agricultural sources typically result in increases in nutrient and herbicide concentrations, urban sources of solutes, particularly from highway runoff, can result in increased loading rates of a more diverse suite of solutes. This analysis addresses many of the potential solutes derived from both sources. Urbanization in the Schuylkill River watershed has resulted in decreases in land used for agricultural purposes, so long-term decreases in nutrient loading along with long-term increases in other dissolved solutes, including metals and other inorganic constituents, might be expected. Effects of increased loading of solutes to the Schuylkill River can be complicated by changes in specific ion activities which are directly related to ionic strength, organic content and other bulk water chemistry characteristics that are dynamic as well (Buckler and Granato 1999, Bricker 1999).

Recent changes in water quality are critical in the Schuylkill River in particular, as this river has some of the highest dissolved solute concentrations of all water supply sources in the northeast. Of twelve major northeastern rivers assessed by Jaworski and Hetling (1996), the Schuylkill had the highest nitrate and total residue (total solids – TS) levels, and the second-highest chloride levels measured as averaged concentrations from 1990 to 1993. Additionally, for the period 1900 to 1993, the Schuylkill had the highest average rate of increase of all watersheds surveyed for nitrate and chloride (by a factor of two over the second-highest rates in the Potomac River) and the second-highest rate of increase in total residuals (just behind the Potomac). These changes are summarized in Table 2.5.2-1. Based on watershed area, the Schuylkill also has the highest mass transport rate for nitrate and ammonia of all major eastern rivers (Jaworski et al. 1997). As such, the Schuylkill has historically been, and is still currently, a heavily impacted major river water supply source.

Table 2.5.2-1 Summary of Historical and Current Water Quality Concentrations and Rates of Change for Northeastern Watersheds

Watershed	USGS Station No.	Timeframe	NO_3(1) (mg/l)	NO_3(2) (mg/l)	NO_3 Change (mg/l/yr)	Cl(1) (mg/l)	Cl(2) (mg/l)	Cl Change (mg/l/yr)	T Res(1) (mg/l)	T Res(2) (mg/l)	T Res Change (mg/l/yr)
Schuylkill	1474500	1913-1993	0.27	2.9	0.0329	6	30	0.3	122	229	1.3375
Potomac	1646580	1921-1993	0.6	1.76	0.0161	3.3	13	0.1347	103	203	1.3689
Delaware	1463500	1906-1993	0.25	1.01	0.0087	2.9	13	0.1161	70	104	0.3908
Blackstone	1111230	1890-1993	0.21	0.97	0.0074	5	44	0.3766	60	154	0.9126
WB Susquehanna	1553500	1906-1993	0.16	0.7	0.0062	4	8	0.046	74	137	0.7241
Rappahannock	1668000	1929-1993	0.15	0.55	0.0063	1.1	5	0.0619	43	53	0.1587
Hudson	1385000	1906-1993	0.18	0.52	0.0039	4	17	0.1494	108	119	0.1264
Connecticut	1184000	1888-1993	0.08	0.35	0.0026	1.5	11	0.0905	53	67	0.1333
Merrimack	1100000	1888-1993	0.07	0.32	0.0024	1.8	19	0.1638	43	68	0.2381
James	2035000	1906-1993	0.06	0.3	0.0028	2.3	9	0.077	89	100	0.1264
Androscoggin	1059010	1906-1993	0.02	0.18	0.0019	2.3	12.5	0.1229	42	66	0.2892
St. John	1015000	1921-1993	0.02	0.15	0.0018	0.7	2.9	0.0306	45	65	0.2778
Average			0.17	0.81	0.0078	2.9	15.4	0.1393	71	114	0.5087

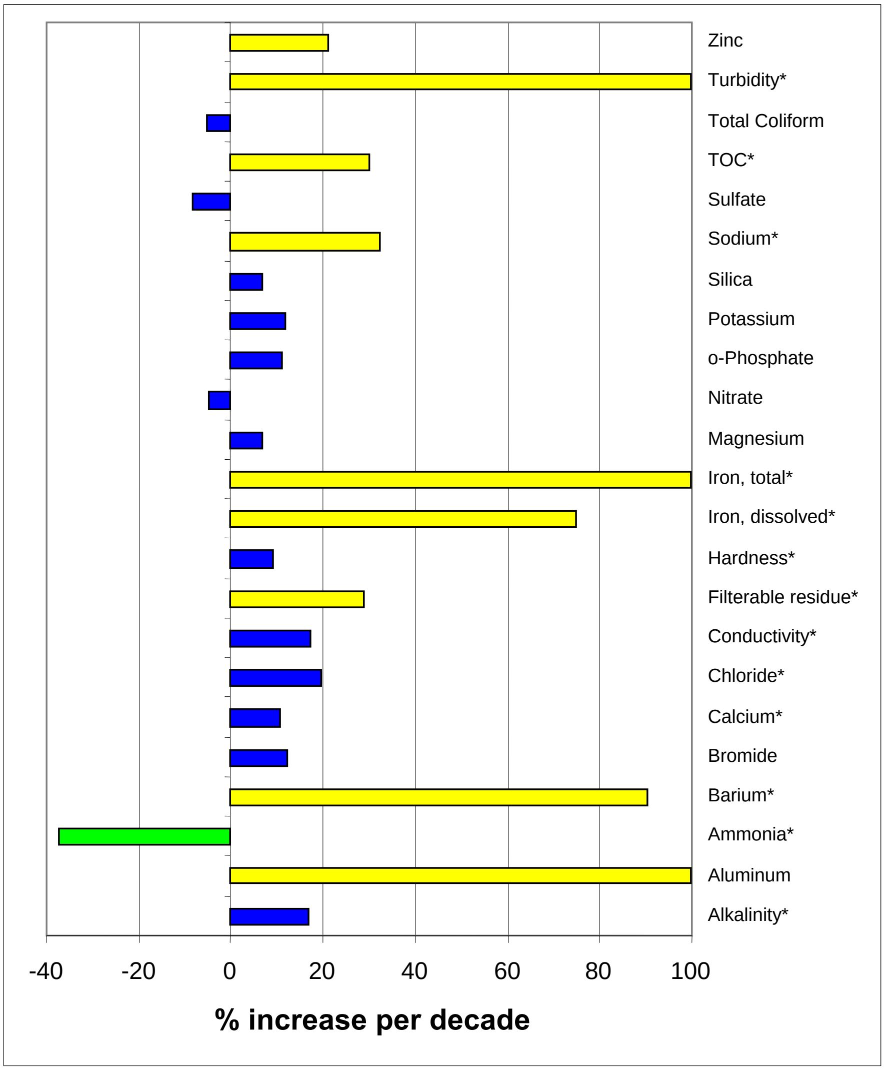
Note: (1) = Earliest historical year
(2) = Four year average for the period 1990-1993
Source: Jaworski et al. 1996

2.5.3 Changes in River Water Quality over the Past Decade

Trends in river water quality over the past decade were examined in order to identify sources of contamination, and to predict future water quality concerns. This process involved the examination of data from 135 different water quality parameters measured at the PWD river intakes between 1990 and 1999 and data from STORET for the Schuylkill River watershed between 1970 and 2000. Of that data set, only 35 parameters had sufficient numbers of measurements or detectable results to conduct a proper analysis that included comparisons between parameters and regional climate and development patterns.

Analysis of the remaining data identified the following trends in water quality changes as shown in Figure 2.5.3-1 and Tables 2.5.3-1 and 2.5.3-2. Parameters in Figure 2.5.3-1 with a yellow or green color coding show a statistically significant increase or decrease, respectively. The blue color coding indicates that a statistically significant percent change in water quality was not observed for that parameter. Overall, 19 water quality parameters increased in concentration over the past decade, while levels of only two parameters (ammonia and sulfate) were observed to decrease significantly, and another two parameters changed very little (nitrate and total coliforms). Of the 19 water quality parameters exhibiting increased trends, most were salts and metals. Future increases in alkalinity, conductivity, sodium, chloride, bromide, iron, manganese, total organic carbon and turbidity in the river water could potentially impact water treatment process operation and finished water quality and therefore required further investigation.

Figure 2.5.3-1 Percent Change per Decade in Schuylkill River Quality Parameters at Philadelphia, PA between 1990 and 1999



** Represents parameters with statistically significant increasing or decreasing trends*

The observed trends led to efforts to determine the origins and types of sources and activities that would significantly impact river water quality. These observed trends suggested that although significant improvements to protect river water quality have been made for point sources, the source of the change in these parameters was most likely increased and more highly polluted runoff. Parameters exhibiting increasing concentration, such as aluminum, iron, and turbidity, can be the result of increased erosion of land surfaces and streambanks due to new construction, or increased flows into streams of more highly polluted water from urban areas and acid mine drainage. Increased loading of salts and metals increase conductivity, a trend confirmed by conductivity readings taken throughout the watershed.

Table 2.5.3-1 Parameters that May Impact Finished Water Quality Based on Trends of the Past Decade or by 2020 Given Current Trends

Parameter	Mean	Max	Min	Predicted Mean Concentration in 2020
Alkalinity (mg/l as CaCo3)	73.9	128	30	101
Turbidity (NTU)	7.85	94.5	0.15	20.9
Conductivity (umhos)	409	775	145	568
o-Phosphate	0.217	1.421	0.027	0.261
Zinc	0.03	0.5	<0.01	.055
Hardness (degrees)	133	251	0.231	162
Iron, total	0.77	40	<0.05	1.25
Iron, dissolved	0.054	0.28	<0.05	0.117
TOC	2.82	7.11	1	4.84
Chloride	41.2	128	8	56.2
Sodium	25	76	0.1	42.3
Manganese, dissolved	0.068	0.2	<0.02	0.116

Units are mg/l unless otherwise specified.
Predicted concentrations are based on linear trends from 1990-2000.

Table 2.5.3-2 Summary of Water Quality Changes in the Schuylkill River During the 1990's that May Impact Water Treatment and Possible Sources

Parameter	Group	Change	Possible Sources/Activities
Conductivity	Physical	Increasing	Polluted Runoff
Chloride & Sodium	Salts	Increasing	Road Runoff
Phosphorous	Nutrients	Increasing	Fertilizers, Farming, Wastewater Discharge
Nitrate	Nutrients	Decreasing	Improved Wastewater Treatment, Less Agricultural Activity in Watershed
Ammonia	Nutrients	Decreasing	Improved Wastewater Treatment, Less Agricultural Activity in Watershed
Total Organic Carbon	Organics	Increasing	Sewage, Decaying Material
TDS/TSS/Turbidity	Particulates	Increasing	Erosion, Construction, Farming/Tilling
Manganese, Aluminum, & Iron	Metals	Increasing	Acid Mine Drainage and Construction

The plausibility that changes in water quality at Philadelphia were representative of other watershed locations was analyzed by comparing trends at Philadelphia with water quality data throughout the watershed. To date, only the analysis of watershed-wide conductivity data is complete. Figure 2.5.3-2 shows the changes in conductivity in the mainstem of the Schuylkill River from near its headwaters (Berne) down to Philadelphia over the past decade. As shown, conductivity increases were greatest in the acid mine drainage-impacted headwaters and downstream in the area starting at the outer boundaries of heavy suburban development in the watershed (Pottstown) down to Philadelphia. Increases in conductivity over the past decade were less in the central, more rural part of the watershed. It is not known whether these increases are related to development, increased roadways/impervious cover runoff, or the characteristics of geology and groundwater.

Figure 2.5.3-2 Watershed-wide Trends in Percent Increase per Decade in Conductivity in the Mainstem of the Schuylkill River from 1990-1999

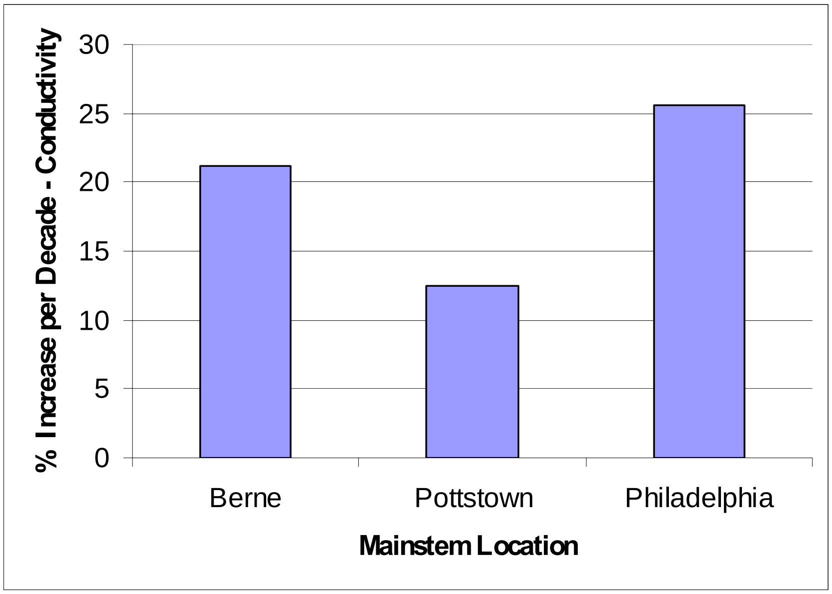


Figure 2.5.3-3 compares the changes in conductivity in the tributaries of the Schuylkill River watershed over the past decade. As shown, several watersheds show significant changes in conductivity over the past decade. The median increase per decade for all locations combined was 15%, but ranged from 3 to 70%, depending upon the location. Valley Creek, Trout Creek, and French Creek in Chester County and Maiden Creek in Berks County show significant increases in conductivity. As shown in Table 2.5.3-3, the greatest conductivity was observed in the two most highly developed tributaries (Valley Creek and Wissahickon Creek) and was as much as two to three times the conductivity observed in other tributaries and locations upstream in the watershed.

Figure 2.5.3-3 Watershed-wide Trends in Percent Increase per Decade in Conductivity in the Tributaries of the Schuylkill River from 1990-1999

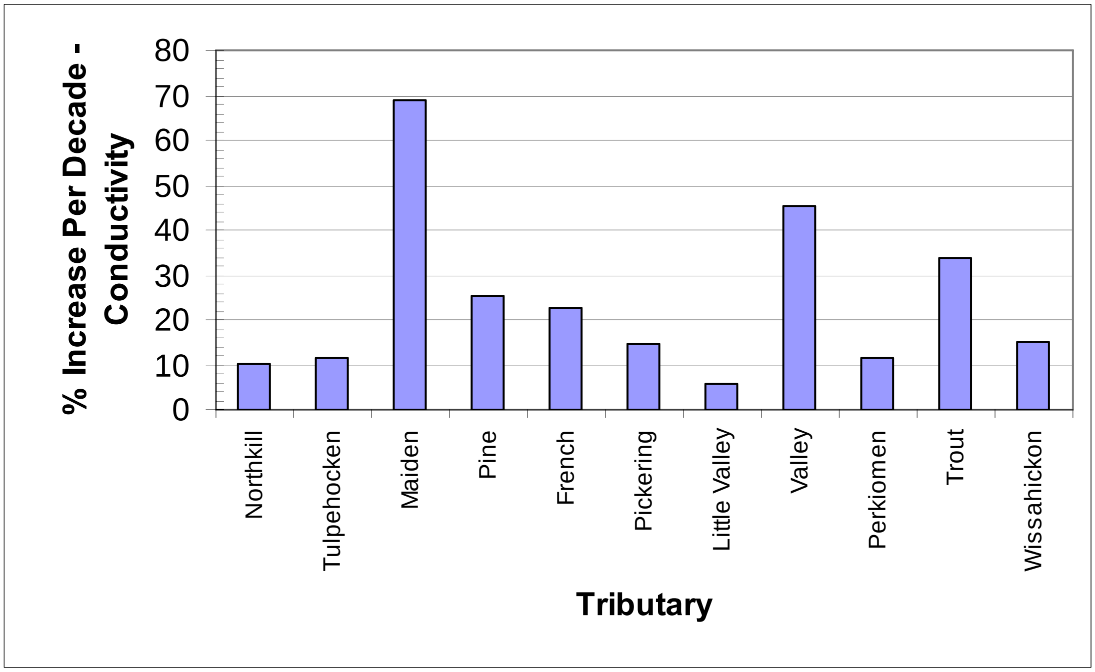


Table 2.5.3-3 Spatial Comparisons of Water Quality Parameters in the Schuylkill River Watershed

Location	Conductivity (umhos)	Total Phosphorus	Chloride	Ammonia	Nitrate	Total Dissolved Solids	Total Organic Carbon
Wissahickon Creek	548.4	0.596		0.075	4.398	365.2	4.21
Valley Creek	508.2	0.038	65.4		2.188	400.4	1.48
Little Valley Creek	474.7	0.080			1.972		
Schuylkill River (Berne)	387.1	0.040		0.095	1.184	307.3	1.99
Schuylkill River (Philadelphia)	373.2	0.183	32.8	0.14	3.031	257.5	3.49
Tulpehocken Creek	367.6	0.077	19.4	0.086	4.735	248.8	2.65
Schuylkill River (Pottstown)	357.0	0.116		0.101	3.110	322.8	2.94
Trout Creek	304.0		23.6		1.970		
Perkiomen Creek	276.4	0.092		0.066	1.596	202.8	4.28
Maiden Creek	255.7	0.049		0.089	3.092	179.0	2.96
Crabby Creek	225.1	0.037	37.9		3.666	203.8	1.56
Green Lane Reservoir	220.7	0.228		1.07	0.065		
Pickering Creek	210.1	0.020	24.0		1.698		
French Creek	154.2	0.045	12.0		1.487		
Pine Creek (Lobachsville)	112.0	0.020	6.5	0.03	0.807	91.5	2.03
Northkill Creek	19.8	0.019	1.4	0.031	0.180	85.2	2.1

All parameters in mg/L unless otherwise noted.

These elevated concentrations and increases in conductivity in the watershed are cumulatively translated into increased conductivity at Philadelphia's water supply intakes near the bottom of the Schuylkill River watershed. The proximity of Philadelphia's water intakes to the Wissahickon Creek and Valley Creek watersheds with their elevated conductivities and highly developed land area makes these areas priorities for investigations into polluted runoff impacts and controls. In addition, the significant changes in conductivity in the Maiden Creek, French Creek, and Trout Creek watersheds indicate that these areas are worthy of protection efforts to identify and mitigate the sources of these impacts to reduce their future affect on river water quality. It appears that changing conductivity may be an early indicator of areas vulnerable to future non-point source impacts from other contaminants.

2.5.4 Differences in Water Quality throughout the Watershed

Analysis of water quality data, impaired stream information, and observations from watershed surveys led to the conclusions regarding the universal water quality issues presented in Table 2.5.4-1. These conclusions were used as a guide for identifying the specific projects outlined in Section 3 of this protection plan.

Table 2.5.4-1 Universal Water Quality Issues

Source Type	Activity	Contaminant Source	Lower Watershed	Middle Watershed	Upper Watershed
Non-point Source	Mining/Acid Mining Drainage (AMD)	AMD and Metals			X
	Agricultural runoff	Nutrients, herbicides/pesticides, pathogens		X	X
	Urban/Suburban Runoff	Salts, nutrients, metals	X	X	
	Erosion	Sediment	X	X	
	Construction	Sediment	X	X	
Point Source	Sewage Discharge	Pathogens, Nutrients	X	X	X
	Abandoned Industrial Facilities	Metals, Organics	X	X	
	Industrial Discharges	Organics, Metals	X	X	
Special/Spills	Oil Pipelines	Organics	X	X	
	Truck/Railroads	Organics	X	X	
	Tire Piles/ Junkyards	Special	X	X	X
	Dams	Contaminated sediment	X	X	
	AST / USTS	Organics	X	X	

Section 3. Prioritization of Potential Sources and Identification of Restoration and Protection Projects

3.1 Priority Protection Areas in the Schuylkill River Watershed

3.1.1 Priority Issues in the Watershed

Between 1999 and 2003, PWD and PADEP expended millions of dollars conducting an award-winning source water assessment for 45 surface water intakes in the Schuylkill River watershed. This program resulted in a comprehensive list of contaminant sources and priority restoration sites. Based on the results of the source water assessments, a number of specific issues were identified to have the greatest potential impact on the water supply. These issues include:

- Abandoned mine drainage
- Pathogens from the discharges of septic systems, sewerage systems, and wastewater treatment plants
- Nutrients and pathogens from agricultural runoff of herbicides, pesticides, fertilizer, and sediment
- Erosion and construction runoff
- Road runoff
- Catastrophic accidents and spills, particularly oil delivery spills, from roads, trains, and fires

Minimizing the impacts of each of these issues through the implementation of restoration projects is a priority of PWD and the SAN, and an individual workgroup has been charged with addressing most of these issues. Source water protection from catastrophic accidents and spills is carried out through the Early Warning System (EWS). The EWS is an integrated, monitoring notification and communication system designed to identify and provide advance warning about source water contamination events. Detailed information on the EWS can be found in Section 5 of this protection plan.

Stormwater

There are a total of 273 impaired stream miles within the Schuylkill watershed due to urban/suburban stormwater runoff, which is the primary cause of impaired stream miles in the Schuylkill River watershed. The majority of the impaired streams are located within Montgomery and Philadelphia Counties, the watershed's most populous counties.

The entire watershed is developing at a significant rate. With this development comes the construction of homes, highways, businesses, and wastewater treatment plants to support that growth. This construction usually entails significant disturbance and moving of earth. The impacts of runoff from construction sites can range from negligible to severe, depending on the characteristics of the construction site, the types of erosion controls that are implemented, and the maintenance of those control structures. During construction significant amounts of sediment can be released into local waterways. The combined impact from the sediment releases at these locations in certain areas can lead to increased dredging and reduced storage capacity in water supply reservoirs. In addition, sediments carry phosphorus into lakes and streams causing algal blooms. The excess nutrients cause our reservoirs to become eutrophic.

Typical in-stream water quality concerns associated with urban stormwater are increased pathogen loadings (*Cryptosporidium* & *Giardia*), higher nutrients and sediment loads, and temperature effects. In addition, along with the increase in impervious surfaces that accompany development, streams lose vital baseflow and are subject to higher flows at greater frequencies than under pre-development conditions. All of these issues can lead to increased treatment costs for water suppliers and poorer in-stream water quality conditions for aquatic organisms and human recreation, both of which are important to the economy and quality of life of the region.

Agriculture

The second leading cause of impaired stream miles in the watershed is agriculture. There are a total of 258 agriculturally impaired stream miles within the Schuylkill River watershed. Over 70% (164 miles) are located within Berks County, the state's 5^{th} leading county in agricultural production. Berks County also comprises over 40% of the land-area within the Schuylkill River watershed. Over the past several decades the amount of available agricultural land has been decreasing in the watershed; however, this does not mean that the level of agricultural activity is decreasing proportionally. It is suspected that residential and commercial development of agricultural land is concentrating agricultural activities into smaller areas that can lead to greater impacts on water quality.

Agricultural activities without proper controls can release pathogens, nutrients, herbicides, pesticides, and sediment into streams, impacting source water quality, recreational water quality, and aquatic life. Erosion and runoff of soils during tillage and farming release significant amounts of sediment and nutrients into the streams and rivers if there are no proper riparian buffer strips in place. In addition, cattle access to streams causes damage to the streambank and make it more susceptible to erosion. Runoff of livestock waste also release pathogens into water supplies.

Abandoned Mine Drainage

AMD is generated when the iron sulfide-bearing materials created by the interaction of the sulfate in coal beds and sulfate-reducing bacteria are exposed to oxygen in air or water during mining. The iron sulfides react with the oxygen to produce hydrogen sulfide, which makes the water more acidic. As the acidity increases, the water's ability to leach metals from the existing rock layers increases. Therefore, the water from mines is not only acidic, but often contains increased concentrations of aluminum, iron, manganese, calcium, magnesium, and sulfate. AMD can also come from culm piles or spoil piles that run off into nearby streams. Usually AMD is discharged from shafts, tunnels, boreholes, drifts, and seeps.

AMD is the third leading cause of impairment in the Schuylkill watershed and the leading cause of impairment in the headwaters, with a total of 222 AMD impaired stream miles. There are 244 known surface and underground mining facilities in the Schuylkill River watershed. Mining of coal, iron, calcium, and stone make up 85% of those operations. Although coal mining has historically been predominant, iron mining is now just as common. Approximately

27% (81) of the mines currently operating in the watershed are coal mines located in the Upper Schuylkill watershed within Schuylkill County.

Discharges from Septic Systems, Sewerage Systems, and Wastewater Treatment Plants
Improper wastewater collection and treatment causes pathogens and nutrients to impact the quality of source water supplies, recreational water quality, and aquatic life. Improper wastewater collection and treatment may result in the following:

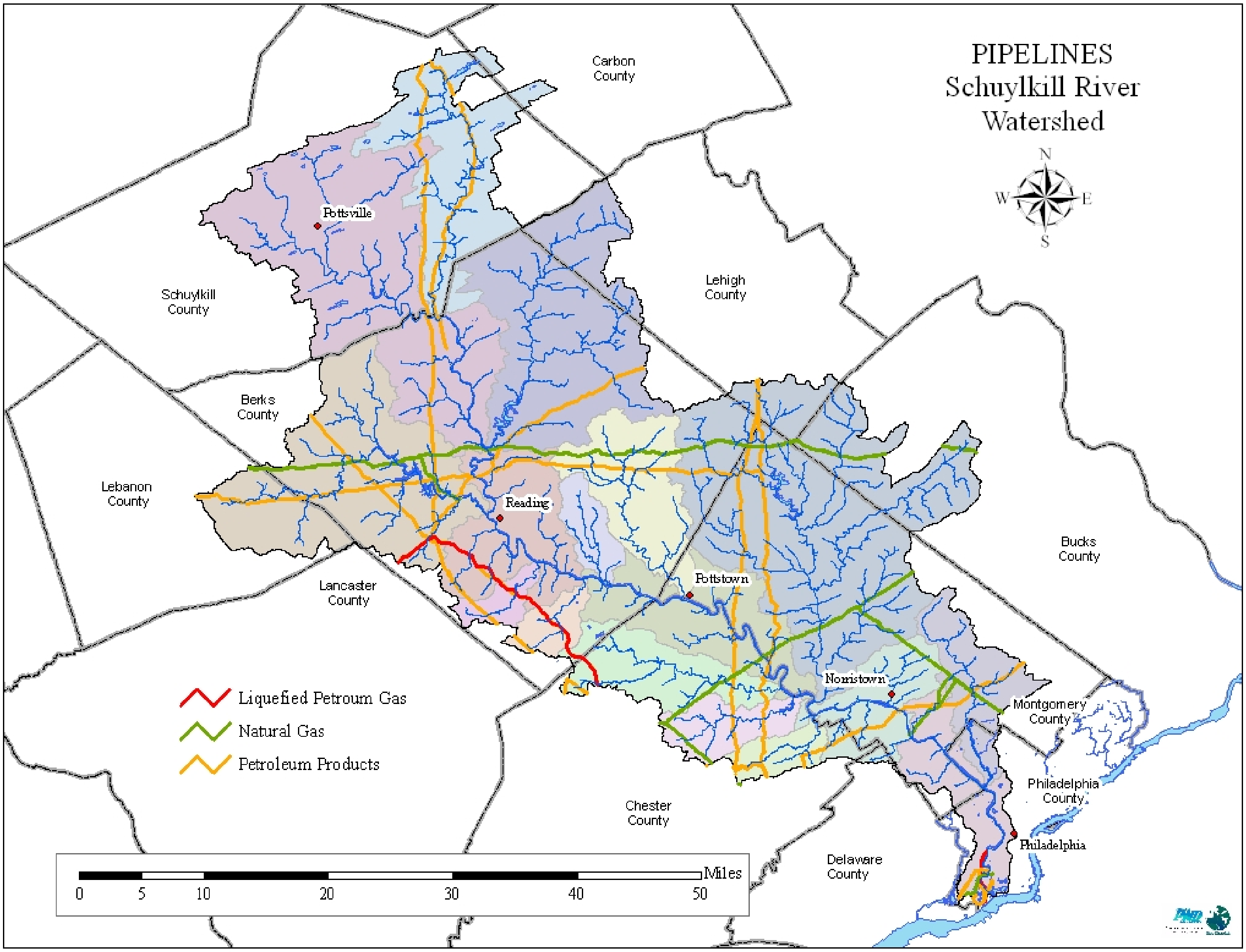
- Wet weather overflows of raw sewage by the sewer system (manholes and pump stations) due to treatment plant capacity limitations (sanitary system overflows or SSOs)
- Wet weather overflows of raw sewage by the sewer system (manholes and pump stations) due to lack of collection system capacity and infiltration/inflow sanitary system overflows (SSOs)
- Wet weather overflows of raw sewage by the sewer system due to combined sewer overflow systems (CSOs)
- Wet weather overflows of raw or partially treated wastewater by the treatment plant due to treatment plant capacity limitations or lack of treatment upgrades
- Dry weather overflows caused by blockages (tree roots, grease, etc.) sometimes due to poor collection system maintenance
- Dry weather discharges of raw sewage due to defective sewer lateral connections to sanitary sewers or improperly operated CSOs
- Routine discharges of raw sewage due to a lack of adequate septic systems, sewerage systems, and enforcement of existing regulations
- Routine discharges of raw sewage due to failing septic systems
- Periodic discharges of partially treated sewage due to treatment plant performance limitations

Catastrophic Accidents and Spills
At any given time throughout the watershed, an accident can occur that releases contaminants which can directly impact the quality of a water supply. These catastrophic events can require public water supply withdrawals to stop for periods of time ranging from a few hours to several days, limiting available water to affected communities. Water suppliers and communities are prepared to deal with such accidents since their emergency response planning includes preparation for such occasions, and therefore the impacts on the public in general are limited. However, when an accident of significant nature does occur under conditions that cannot be anticipated, the impact can be quite dramatic. In order to decrease the potential impacts of these events, PWD in partnership with the Delaware River Basin Commission has developed the Delaware Valley Early Warning System (EWS). The EWS is a fully automated system, which provides early detection and notification of discharges or changes in water

quality directly to water suppliers. Detailed information on the EWS can be found in Section 5 of this protection plan.

Pipelines also pose a risk to water suppliers in the watershed. The Schuylkill River has many major petroleum pipeline crossings, unknown to most people. The age and location of these pipelines are largely unknown and the petroleum suppliers are just now voluntarily supplying partial information to local and federal governments. It is believed that these pipelines are of significant age and nearing their life expectancy. Locations of known pipelines are shown in Figure 3.1.1-1.

Figure 3.1.1-1 Pipelines in the Schuylkill River Watershed



In order for PWD and the SAN to effectively address the many issues listed above, there must first be a clear understanding of which areas should be targeted for restoration and protection efforts. The next section outlines the methodology developed by PWD to prioritize the point and non-point sources of contamination in the watershed and the results of the prioritizations.

3.1.2 Prioritization Methodology

During the source water assessment process, a susceptibility analysis was completed *for each public water supply intake* within the Schuylkill River watershed for the following ten parameters: chloride, *Cryptosporidium*, fecal coliform, metals, nitrates, petroleum hydrocarbons, phosphorus, total organic compounds (TOC), total suspended solids (TSS), and volatile organic compounds. The results of the susceptibility analyses can be found in the intake-specific reports generated during the source water assessments, which are available for public review at the PADEP regional offices.

For the current, implementation phase of the source water program, prioritization results are available in this protection plan. These prioritizations were completed on a watershed-wide basis and included only the parameters that were found to be the greatest potential threat to each drinking water intake during the assessments. These contaminants include *Cryptosporidium,* fecal coliform, nutrients (nitrate and phosphorus), total organic carbon (TOC), and total suspended solids (TSS). As a supplement to the individual parameter prioritization results, a combined prioritization for all six parameters was completed as well.

According to the Little Schuylkill River and Upper Schuylkill River Assessment Reports prepared by L. Robert Kimball & Associates in 2001, metals are also a priority in the middle and upper Schuylkill River watershed. The source of metals can be directly linked to abandoned mine discharges at specific sites within the upper reaches of the watershed. While metals are addressed through various restoration and protection projects outlined in this source water protection plan, a new prioritization for metals was not conducted, because the sources are well documented.

Point Sources

As explained in the "Contaminant Source Inventory" section of this protection plan, an inventory of potential sources of contamination was developed with all sites included in the PCS, RCRA, AST, and TRI databases. Through a series of screening processes, the potential sources were reduced to the most significant point sources *for a specific intake*. A final ranking of these most significant sources was carried out to produce a list of the top 100 sites for each intake. This final ranking is based on the following criteria and criteria weights:

1. Relative Impact at Intake (weight 12 percent): a measure of the expected concentration as a ratio of a relevant water quality standard.

2. Time of Travel (weight 5 percent): calculated from the location of the source to the intake based on high flow conditions.

3. Potential for Release/Controls (weight 14 percent): a qualitative criterion measuring the likelihood of accidental releases.

4. Potential for Release Frequency (weight 14 percent): based on the type of source, this could range from daily (permitted discharges) to rare (accidental spills)

5. Violation Type/Frequency (weight 10 percent): a measure of the performance of the source in meeting regulatory requirements.

6. Location (weight 5 percent): relative to the zone delineation of the intake.

7. Existing Removal Capacity (weight 10 percent): a measure of the ability of the existing water treatment system to remove the released contaminant from the raw water.

8. Impact on Treatment Operation (weight 10 percent): a measure of possible impacts of the contaminant on the operation of the treatment plant

9. Potential Health Impacts (weight 20 percent): a rough measure of the toxicity of the pollutant or mix of pollutants.

It should be noted that the PCS database identified wastewater and sewage disposal facilities as either major facilities with discharges of more than 1 million gallons per day (MGD) or minor facilities with discharges of less than 1 MGD. Since no effluent data were available for minor discharges and limited data were available for major discharges, an assumption was made for the average discharge rate and concentration of contaminants. Default flows of 1 MGD for large facilities and 0.1 MGD for small facilities were used. Some major facilities had concentration data. For others, assumed concentrations were used, based on the site SIC code and median concentrations for similar facilities for which data were available. Table 3.1.2-1 shows the assumed concentrations used during the source water assessments and in this prioritization. Slight changes in assumptions were made as additional data are now available since the source water assessments were completed. More detailed information on the approach used to determine the final ranking can be found in Section 2.2.4 of the SWAP reports.

Table 3.1.2-1 Assumed Concentrations for Sources with No Available Data

Contaminant	Minor Sources (2000 Assessments)		Minor Sources (2004 Prioritization)		Major Sources (2000 Assessments)		Major Sources (2004 Prioritization)	
Cryptosporidium (oocysts/day)	3,780,000.00	Based on 10 per liter at a flow of 100,000 gpd.	3,780,000.00	Based on 10 per liter at a flow of 100,000 gpd.	37,800,000.00	Based on 10 per liter at a flow of 1000,000 gpd.	37,800,000.00	Based on 10 per liter at a flow of 1000,000 gpd.
Fecal Coliform (#/day)	75,600,000	Based on 2,000 #/100 ml at a flow of 100,000 gpd.	75,600,000	Based on 2,000 #/100 ml at a flow of 100,000 gpd.	756,000,000	Based on 2,000 #/100 ml at a flow of 1000,000 gpd.	756,000,000	Based on 2,000 #/100 ml at a flow of 1000,000 gpd.
Nutrients-Conservative (lbs nitrate-nitrogen per day)	7.2	Based on median effluent quantity of 2 lbs/day ammonia and conversion factor of 3.6lbs nitrate-n per lb ammonia	7.2	Based on median effluent quantity of 2 lbs/day ammonia and conversion factor of 3.6lbs nitrate-n per lb ammonia.	96.66	Based on median effluent quantity of 26.85 lbs/day ammonia and conversion factor of 3.6lbs nitrate-n per lb ammonia.	96.66	Based on median effluent quantity of 26.85 lbs/day ammonia and conversion factor of 3.6lbs nitrate-n per lb ammonia.
Nutrients-Non Conservative (lbs P/day)	1.668	Based on typical effluent limit of 2 mg/l and a flow of 100,000 gpd.	1.668	Based on typical effluent limit of 2 mg/l and a flow of 100,000 gpd.	10	Based on median effluent quantity of 10 lbs/day phosphorous.	10.8	Based on median effluent quantity of 10.8 lbs/day phosphorous.
DBP Precursors (lbs TOC/day)	41.65	Based on 1/10th the quantity of major sources.	39.7	Based on 1.1 lbs CBOD per lb TOC and a median CBOD discharge of 43.6 lbs/day.	416.56	Based on 1.6 lbs TOC per lb BOD and a median BOD discharge of 260.35 lbs/day).	115.45	Based on 1.1 lbs CBOD per lb TOC and a median CBOD discharge of 127 lbs/day.
Turbidity (lbs TSS/day)	25.3	Based on 1/10th the quantity of major sources.	24.2	Based on 1/10th the quantity of major sources.	253	Based on median discharge of 253 lbs TSS/day.	242	Based on median discharge of 242 lbs TSS/day.

To determine the highest priority sources within *the entire watershed*, PWD used the results of the susceptibility analysis for point sources for each of the intakes. PWD focused on the results of the NPDES permitted dischargers in the watershed as they were the largest group of potential sources identified during the susceptibility analysis. PWD classified any NPDES point sources identified as a high, moderately-high, or moderate priority during the susceptibility analysis, to be potentially significant sources to an intake. PWD then reduced these sources to a final list of potential high priority sources and updated the information available on the sources using the PCS database. The final ranking is based on the following criteria and criteria weights:

1. Source Quantities (**weight 55 percent**): actual load amounts were used when available. When no data were available, estimated loads were used by calculating the median of actual load data from similar facilities. Higher loads resulted in a higher priority rank.

2. Discharge Monitoring Report Violations (**weight 20 percent**): reported violations between the years 1997 and 2003 were totaled, with facilities ranked higher if they had more reported violations.

3. Intake Withdrawal Weight (**weight 5 percent**): total estimated annual withdrawal from all intakes for which a source has been identified as a highest, moderately high, or moderate priority pollutant source within the intake's Zone B delineation. The greater the amount of public water supply withdrawals a source could impact, the higher its priority.

4. Number of Intakes within Zone A (**weight 20 percent**): total number of intakes from which the source is located within the five hour time of travel.

The intake withdrawal score, in effect, reflects the significance of the intake based upon its average daily withdrawal when determining watershed-wide priorities. A source identified as a potential source for two large intakes could receive a higher watershed-wide priority rating than a source that is identified as a potentially significant source for four small intakes. Table 3.1.2-2 shows the number of gallons each intake withdraws from the river each day, and the weight assigned to each intake for the prioritization based upon the average number of gallons withdrawn daily. Some water suppliers withdraw water from more than one intake. Actual intake withdrawal data was used if it was available. In cases where it was not available, the total number of gallons withdrawn was divided evenly between the intakes.

Table 3.1.2-2 Schuylkill Watershed Intake Withdrawal Summary

Water Treatment Plant	MGDs	MGYs	Intake Score
Ambler	0.5	182.5	0.2%
Auburn Municipal Authority	0.055	20.075	0.0%
Birdsboro	0.125	45.625	0.1%
Birdsboro	0.125	45.625	0.1%
Birdsboro	0.125	45.625	0.1%
Birdsboro	0.125	45.625	0.1%
Boyertown	0.2	73	0.1%
Boyertown	0.2	73	0.1%
Boyertown	0.2	73	0.1%
East Greenville	0.25	91.25	0.1%
Hamburg Center	0.1	36.5	0.0%
Mary D Community Association	0.058	21.17	0.0%
Minersville Municipal Water Authority	1	365	0.4%
PA American - Norristown WTP	5.25	1916.25	2.2%
PA American - Norristown WTP	5.25	1916.25	2.2%
PA American - Royersford	3.7	1350.5	1.5%
Phoenixville	2.8	1022	1.1%
Pottstown	5	1825	2.1%
PSW - Pickering WTP	13.3333	4866.67	5.5%
PSW - Pickering WTP	13.3333	4866.67	5.5%
PSW - Pickering WTP	13.3333	4866.67	5.5%
PSW - Upper Merion	5/12.5*	2700	3.0%
PWD - Belmont	60	21900	24.6%
PWD - Queen Lane	85	31025	34.9%
Reading Area Water Authority	13.5	4927.5	5.5%
Schuylkill Haven Borough Water	2.2	803	0.9%
SCMA - Eisenhuth Reservoir	0.96667	352.833	0.4%
SCMA - Indian Run Reservoir	1	365	0.4%
SCMA - Kauffman Reservoir	0.375	136.875	0.2%
SCMA - Mt. Laurel Reservoir	0.375	136.875	0.2%
SCMA - Pine Run Reservoir	0.96667	352.833	0.4%
SCMA - Wolfe Creek Reservoir	0.96667	352.833	0.4%
Tamaqua Area Water Auth. - Still Creek	2	730	0.8%
Wernersville State Hospital	0.11	40.15	0.0%
Western Berks	3.5/5.0**	1440	1.6%
Total			100.0%

* Upper Merion withdraws 5 MGD in winter and between 10-15 in summer. MGY is based on 8 winter months and 4 summer months at 12.5 MGD. ** Western Berks withdraws 3.5 MGD in winter and 5.0 in summer. MGY is based on 8 winter months and 4 summer months.

PWD conducted analyses of the highest priority point sources for *Cryptosporidium,* fecal coliform, nutrients (nitrate and phosphorus), TOC, and TSS. A prioritization based on all six parameters combined was run as well. For the nutrients prioritization, which includes more than one contaminant, if a source is identified as a priority for both parameters, then it is weighted more heavily than a source which ranks high for only one contaminant. The criteria weight is evenly distributed between nitrate and phosphorus when calculating the final prioritization for nutrients.

Non-Point Sources

As explained in the "Contaminant Source Inventory" and "Build Out" sections of this protection plan, PWD developed the Schuylkill River Loading Model (SRLM) to estimate pollutant loads from rainfall runoff throughout the watershed. To determine the highest priority subsheds within *the entire watershed*, PWD used the results of the susceptibility analysis for non-point sources for each of the intakes. PWD classified any subsheds with an intake identified as a high, moderately-high, or moderate priority during the susceptibility analysis, to be potentially significant sources. Using the same method developed in the point source, intake-specific analysis, PWD conducted a separate analysis of the highest priority subsheds for non-point pollution sources of *Cryptosporidium,* fecal coliform, nutrients (nitrate and phosphorus), TOC, and TSS. A prioritization of all six parameters was run as well. For the nutrients prioritization, which includes more than one contaminant, if a source is identified as a priority for both nitrate and phosphorus, then it is weighted more heavily than a source which ranks high for only one of the parameters.

PWD was not funded to complete a source water assessment for the Reading Area Water Authority under its original source water assessment grant. Therefore, potential point and non-point sources for this intake were taken from the *Watershed Assessment for Reading, Pennsylvania* conducted by the Cadmus Group, Inc. in 1998. All sources contributing to the Reading intake were considered potentially significant sources in this prioritization.

Criteria were assigned weights similar to those used for point sources for the watershed-wide prioritizations of non-point sources. The final ranking is based on the following criteria and criteria weights: source quantities (**55% weight**); intake withdrawal weight (**15% weight**); number of intakes within Zone A (**35% weight**).

3.1.3 Prioritization Results

The following set of tables and figures shows the prioritization results based upon the criteria scores for all six combined contaminants, as well as the individual contaminant results for *Cryptosporidium*, fecal coliform, nutrients, TOC, and TSS.

Combined Parameters

All significant point and non-point sources for all six parameters were used for a combined prioritization for the entire watershed. As seen in Figure 3.1.3-1 and Tables 3.1.1-1 and 3.1.3-2, high priority point sources are located primarily along the mainstem of the Schuylkill River between Reading and Norristown and within the Wissahickon subwatershed. Two other moderately-high scoring sites, the Myerstown Sewage Treatment Authority and the Schuylkill Haven Sewage Treatment Plant are located outside of these areas in the Tulpehocken and Upper Schuylkill subwatersheds. The Myerstown plant reported high levels of TSS and has an intake withdrawal weighting of almost 80% while the Schuylkill Haven facility reported very high levels of TOC, has an intake withdrawal weighting of approximately 78%, and 79 discharge monitoring report violations on record between 1997 and 2003.

The high priority subsheds are scattered throughout the Schuylkill watershed and include areas within the Lower Schuylkill, Wissahickon, and Tulpehocken majorsheds. Interestingly, the Hay Creek subwatershed scored highly as a priority protection area in this prioritization. Hay Creek has an exceptional value water quality stream designation but is also a small subwatershed within the Zone A delineation of five drinking water intakes. The Lower Perkiomen subwatershed, specifically the area within the municipalities of East Norriton, Whitpain, and North Wales scored high. This is a subwatershed of particular concern. According to the U.S. Census, the Perkiomen subwatershed experienced the greatest increase in population of all subsheds in the Schuylkill River watershed from 1990 to 2000. Municipal officials should take care to ensure that proper stormwater ordinances are in place throughout these areas to protect against the impacts of increased development.

Figure 3.1.3-1 Priority Source Locations (Combined)

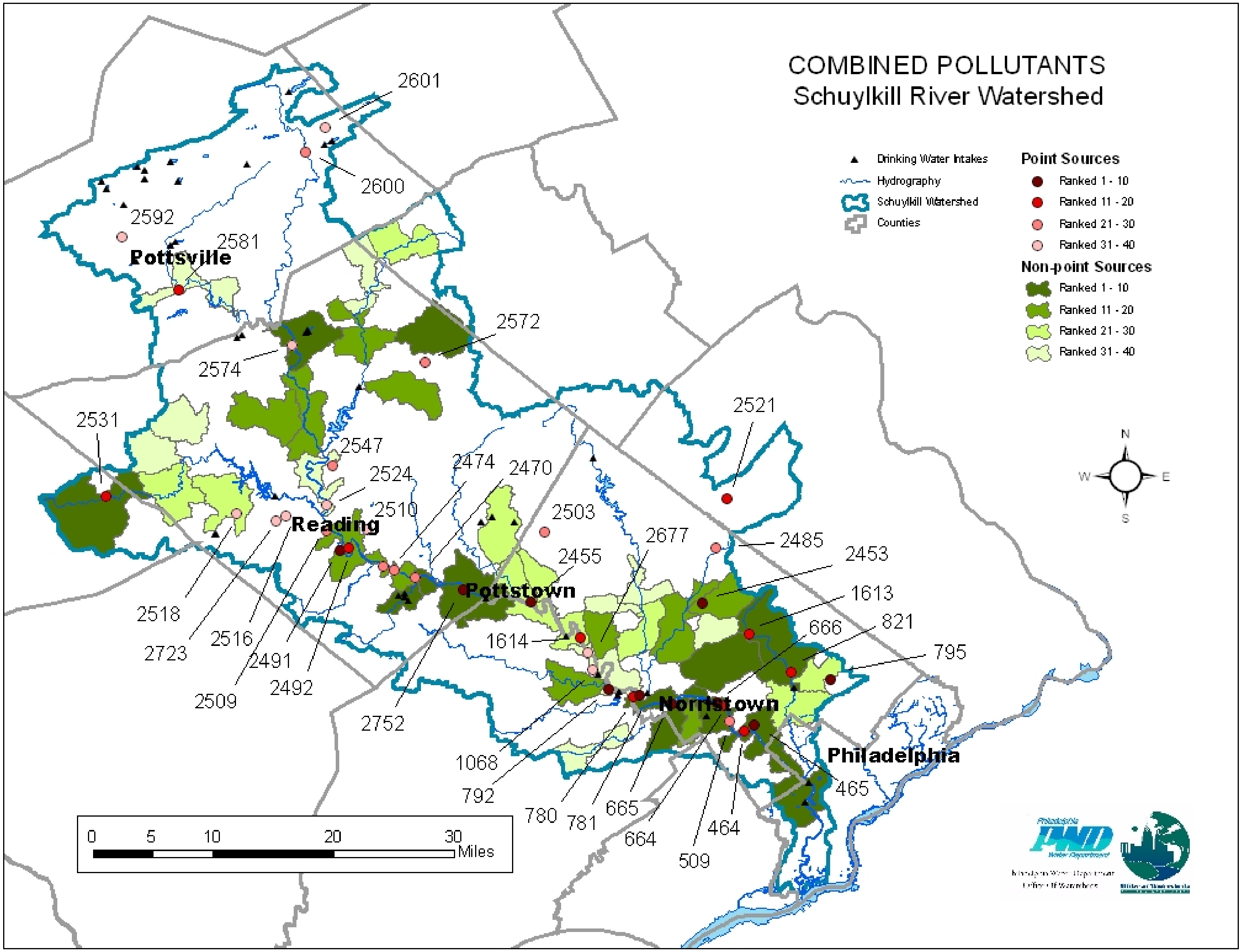


Table 3.1.3-1 Priority Point Source Locations for Combined Parameters in the Schuylkill River Watershed

Source ID	Source Name	Fecal Coliform (col/day)	Crypto (oocysts/ day)	Nitrate (lbs./day)	Phos-phorus (lbs./day)	TSS (lbs./day)	TOC (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
2491	READING CITY	7.560E+08	3.780E+07	1.172E+05	1.080E+01	5.534E+04	7.262E+03	92	78.29	1	1
781	MONTGOMERY COUNTY SEW AUTH	7.560E+08	3.780E+07	2.815E+03	1.080E+01	1.440E+04	3.540E+03	218	67.50	2	2
2455	POTTSTOWN BORO	7.560E+08	3.780E+07	1.300E+03	1.080E+01	2.279E+04	5.085E+03	39	76.11	3	3
666	NORRISTOWN MUN WASTE AUTH	7.560E+08	3.780E+07	4.918E+03	1.080E+01	8.024E+05	3.078E+03	24	62.95	2	4
665	UPPER MERION MUN UTILITY AUTH	7.560E+08	3.780E+07	3.514E+03	1.080E+01	2.088E+03	1.086E+03	13	67.50	4	5
2453	UPPER GWYNEDD-TOWAMENCIN MUN	8.400E+01	3.780E+07	1.127E+03	1.420E+02	1.394E+03	7.436E+02	25	73.29	3	6
792	PHOENIXVILL BORO STP	7.560E+08	3.780E+07	1.930E+03	1.080E+01	2.383E+03	1.206E+03	6	73.29	3	7
465	WHITEMARSH TWP SEW AUTH	7.560E+08	3.780E+07	1.476E+03	1.080E+01	1.500E+03	1.458E+03	72	62.95	2	8
795	ABINGTON TWP COMM-WWTR TRTMT P	7.560E+08	3.780E+07	2.380E+03	1.080E+01	5.474E+03	1.617E+03	51	62.95	2	9
2752	120 OLD PHILADELPHI	7.560E+08	3.780E+07	1.152E+02	1.080E+01	8.588E+03	9.782E+02	4	78.29	2	10
1613	UPPER GWYNEDD TWP	7.560E+08	3.780E+07	2.952E+02	1.080E+01	6.778E+03	4.145E+03	61	62.95	1	11
780	VALLEY FORGE SEWER AUTHORITY	7.560E+08	3.780E+07	2.669E+03	1.080E+01	1.001E+04	2.194E+03	12	67.50	2	12
2581	SCHUYLKILL HAVEN MUN AUTH-STP	7.560E+08	3.780E+07	6.552E+02	1.080E+01	4.401E+03	2.668E+03	79	78.29	0	13
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	7.560E+08	3.780E+07	8.064E+03	1.160E+02	2.474E+03	3.677E+03	0	73.29	0	14
2531	MYERSTOWN STP	7.560E+08	3.780E+07	3.636E+02	2.274E+01	9.580E+02	7.373E+02	31	80.00	1	15
1614	LIMERICK TWP MUN AUTH	7.560E+08	3.780E+07	9.000E+01	1.080E+01	4.720E+02	2.191E+02	4	76.11	2	16
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	7.560E+08	3.780E+07	2.243E+03	1.080E+01	1.060E+04	1.973E+03	19	62.95	2	17
2492	GPU GENERATION INC TITUS GENERATING STATION	7.560E+08	3.780E+07	9.666E+01	1.080E+01	9.800E+02	4.166E+02	36	78.29	1	18
821	AMBLER BORO	7.560E+08	3.780E+07	4.374E+02	1.080E+01	1.100E+04	5.174E+02	22	62.95	2	19
464	CONSHOHOCKEN SEW TREAT. PLT.	7.560E+08	3.780E+07	7.128E+02	1.080E+01	8.273E+03	4.091E+02	12	62.95	2	20
2470	BIRDSBORO BORO MUN AUTH	7.560E+08	3.780E+07	1.328E+03	1.080E+01	1.071E+03	2.455E+02	18	78.29	1	21
2474	EXETER TOWNSHIP WWTR TRTMT PLT	7.560E+08	3.780E+07	1.845E+03	1.080E+01	3.602E+03	7.664E+02	8	78.29	1	22
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	7.560E+08	3.780E+07	1.638E+02	1.080E+01	7.500E+01	4.166E+02	10	78.29	1	23

Source ID	Source Name	Fecal Coliform (col/day)	Crypto (oocysts/ day)	Nitrate (lbs./day)	Phos-phorus (lbs./day)	TSS (lbs./day)	TOC (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
2572	KUTZTOWN MUN AUTH MUN SEW TREATMENT PLANT	7.560E+08	3.780E+07	5.418E+02	1.080E+01	5.990E+02	1.755E+02	12	78.29	1	24
2485	BOROUGH OF SOUDERTON	7.560E+08	3.780E+07	2.311E+02	3.720E+01	2.047E+03	4.280E+02	6	73.29	1	25
509	LUKENS STEEL CO	7.560E+08	3.780E+07	9.666E+01	1.080E+01	4.827E+02	4.166E+02	0	62.95	2	26
2509	WYOMISSING VALLEY JOINT MUN AU	7.560E+08	3.780E+07	2.113E+03	1.080E+01	2.422E+03	1.043E+03	37	78.29	0	27
2547	NGK METALS CORP.	7.560E+08	3.780E+07	9.666E+01	1.080E+01	1.218E+02	4.166E+02	47	78.29	0	28
2503	BERKS MONTGOMERY MUNICIPAL AUTH	7.560E+08	3.780E+07	1.130E+03	4.540E+01	1.225E+03	5.283E+02	29	73.29	0	29
2600	TAMAQUA BOROUGH AUTHORITY-STP	7.560E+08	3.780E+07	8.136E+02	1.080E+01	8.650E+02	4.827E+02	38	78.29	0	30
2574	HAMBURG MUN AUTH	7.560E+08	3.780E+07	9.666E+01	1.080E+01	2.248E+03	2.955E+02	25	78.29	0	31
2524	CARPENTER TECHNOLOGY CORP	7.560E+08	3.780E+07	8.806E+03	1.080E+01	1.300E+02	4.166E+02	8	78.29	0	32
2601	COALDALE-LANSFORD-SUMMIT HILL SEWER AUTHORITY	7.560E+08	3.780E+07	9.666E+01	1.080E+01	1.418E+03	5.818E+02	6	78.29	0	33
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	7.560E+08	3.780E+07	2.412E+02	1.080E+01	9.160E+02	2.468E+02	9	78.29	0	34
2516	SPRING TWP MUN AUTH	7.560E+08	3.780E+07	4.648E+02	1.080E+01	3.160E+02	3.455E+02	5	78.29	0	35
2723	SINKING SPRING BORO MUN AUTH	7.560E+08	3.780E+07	9.666E+01	1.080E+01	4.550E+02	2.109E+02	0	78.29	0	36
1068	PECO ENERGY CO-CROMBY GENERATING	7.560E+07	3.780E+06	7.200E+00	1.668E+00	2.420E+01	3.970E+01	0	74.51	4	37
2677	SPRING CITY BOROUGH SEWAGE PLANT	7.560E+07	3.780E+06	7.200E+00	1.668E+00	2.420E+01	3.970E+01	0	74.51	4	37
2592	MINERSVILLE SEW AUTH-STP	7.560E+08	3.780E+07	9.666E+01	1.080E+01	2.240E+02	1.864E+02	0	78.29	0	39
2518	ROBESONIA-WERNERSVILLE M/A OF	4.575E+01	3.780E+07	1.282E+02	1.642E+01	5.397E+02	2.809E+02	20	80.00	1	40

Table 3.1.3-2 Priority Non-Point Source Locations for Combined Parameters in the Schuylkill River Watershed

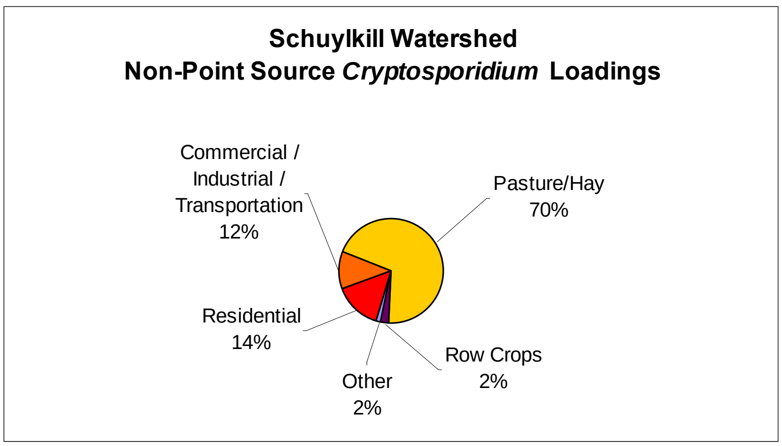
Source ID	Source Name	Fecal Coliform (col/day)	Crypto (oocysts/ day)	Nitrate (lbs./day)	Phosphorus (lbs./day)	TSS (lbs./day)	TOC (lbs./day)	Intake Weight (%)	Zone A	Score
90236	Tulpehocken Creek-236	1.037E+12	1.548E+08	2.351E+02	4.592E+01	2.464E+04	3.769E+02	80.00	0	1
90008	Wissahickon Creek-008	5.220E+12	1.173E+08	1.355E+02	2.074E+01	1.177E+04	6.651E+02	62.95	2	2
90024	Stony Creek-024	4.272E+12	9.204E+07	1.090E+02	1.675E+01	8.298E+03	4.904E+02	65.23	3	3
90289	Schuylkill River-289	1.013E+12	8.122E+07	8.868E+01	1.642E+01	9.942E+03	2.791E+02	78.33	3	4
90003	Schuylkill River-003	9.316E+12	1.697E+08	1.895E+02	2.370E+01	6.216E+03	1.088E+03	26.05	0	5
90027	Trout Creek-027	2.323E+12	4.083E+07	4.978E+01	6.587E+00	5.062E+03	2.941E+02	67.50	4	6
90265	Mill Creek-265	9.316E+10	9.311E+07	1.264E+02	2.591E+01	1.543E+04	2.217E+02	78.29	1	7
90164	Schuylkill River-164	1.679E+12	4.893E+07	5.751E+01	8.318E+00	5.348E+03	2.566E+02	76.11	3	8
90190	Hay Creek-190	2.093E+11	4.940E+06	6.566E+00	9.952E-01	4.806E+02	3.699E+01	78.50	5	9
90020	Schuylkill River-020	3.611E+12	7.000E+07	8.839E+01	1.034E+01	3.552E+03	4.762E+02	62.95	2	10
90153	Mingo Creek-153	6.881E+11	2.385E+07	2.455E+01	4.238E+00	2.204E+03	9.780E+01	74.51	4	11
90282	Schuylkill River-282	1.084E+12	1.036E+08	1.091E+02	2.063E+01	1.275E+04	2.946E+02	78.29	0	12
90045	Towamencin Creek-045	2.024E+12	3.438E+07	4.112E+01	5.869E+00	2.047E+03	2.042E+02	73.29	3	13
90193	Schuylkill River-193	2.884E+12	6.632E+07	7.451E+01	9.568E+00	5.936E+03	3.993E+02	78.29	1	14
90283	Irish Creek-283	8.157E+10	1.079E+08	1.005E+02	2.160E+01	1.489E+04	2.020E+02	78.29	0	15
90248	Moselem Creek-248	2.695E+11	6.225E+07	9.933E+01	1.973E+01	1.049E+04	1.710E+02	78.29	1	16
90135	French Creek-135	1.434E+12	3.641E+07	3.631E+01	5.644E+00	3.033E+03	1.906E+02	73.29	3	17
90025	Crow Creek-025	1.270E+12	2.006E+07	2.472E+01	3.427E+00	1.035E+03	1.365E+02	67.50	4	18
90267	Maiden Creek-267	4.497E+10	7.495E+07	7.580E+01	1.583E+01	1.061E+04	1.735E+02	78.29	1	19
90042	Skippack Creek-042	9.261E+11	3.237E+07	3.239E+01	5.636E+00	3.052E+03	1.483E+02	73.29	3	20
90154	Schuylkill River-154	1.889E+12	4.738E+07	5.407E+01	7.284E+00	3.708E+03	2.529E+02	74.51	2	21
90049	Perkiomen Creek-049	1.057E+12	2.876E+07	3.033E+01	4.674E+00	2.737E+03	1.376E+02	73.29	3	22
90165	Manatawny Creek-165	7.492E+11	1.966E+07	2.151E+01	3.014E+00	3.748E+03	1.018E+02	76.11	3	23
90277	Ontelaunee Creek-277	8.623E+10	8.678E+07	9.102E+01	1.878E+01	1.239E+04	2.186E+02	78.29	0	24
90167	Ironstone Creek-167	2.744E+11	2.557E+07	2.240E+01	4.497E+00	3.012E+03	8.097E+01	76.29	3	25
90213	Spring Creek-213	3.410E+11	8.088E+07	9.158E+01	1.859E+01	1.153E+04	1.888E+02	80.00	0	26
90234	Tulpehocken Creek-234	3.783E+11	7.342E+07	9.259E+01	1.878E+01	1.099E+04	1.820E+02	80.00	0	27
90007	Wissahickon Creek-007	2.630E+12	4.098E+07	6.029E+01	8.229E+00	2.778E+03	3.005E+02	62.95	2	28
90009	Sandy Run-009	2.342E+12	4.348E+07	5.505E+01	7.953E+00	3.676E+03	3.003E+02	62.95	2	29

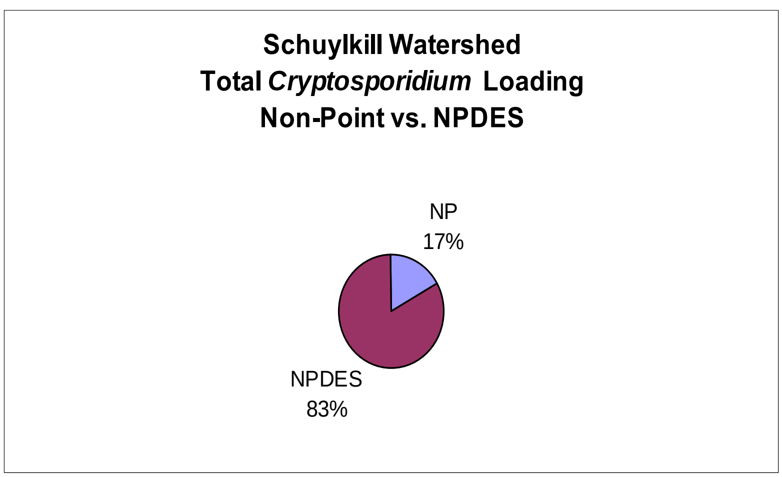
90163	Sprogles Run-163	7.746E+11	1.701E+07	1.827E+01	2.741E+00	1.509E+03	9.511E+01	76.11	3	30
90224	Little Northkill Creek-224	5.189E+10	7.857E+07	8.718E+01	1.829E+01	1.161E+04	1.568E+02	80.00	0	31
90105	Schuylkill River-105	1.648E+12	3.767E+07	4.639E+01	5.952E+00	2.727E+03	2.175E+02	73.29	2	32
90238	Schuylkill River-238	2.495E+12	6.892E+07	7.896E+01	1.141E+01	7.190E+03	3.679E+02	78.29	0	33
90044	Zacharias Creek-044	3.042E+11	2.032E+07	1.971E+01	3.825E+00	2.387E+03	6.837E+01	73.29	3	34
90035	Valley Creek-035	1.431E+12	3.720E+07	4.266E+01	6.633E+00	4.837E+03	2.206E+02	67.50	2	35
90051	Lodal Creek-051	3.553E+11	1.809E+07	1.769E+01	3.250E+00	1.990E+03	7.096E+01	73.29	3	36
90233	Mill Creek-233	1.532E+10	7.706E+07	7.479E+01	1.607E+01	1.087E+04	1.467E+02	80.00	0	37
90052	Perkiomen Creek-052	4.631E+11	1.570E+07	1.545E+01	2.578E+00	1.415E+03	6.653E+01	73.29	3	38
90295	Schuylkill River-295	1.308E+12	6.183E+07	7.633E+01	1.243E+01	8.845E+03	2.995E+02	78.29	0	39
90271	Maiden Creek-271	1.290E+10	5.046E+07	5.226E+01	1.116E+01	7.388E+03	1.456E+02	78.29	1	40

Cryptosporidium

As seen in Figure 3.1.3-2, *Cryptosporidium* is found both in point source discharges and runoff but is primarily associated with agricultural land uses, specifically pasture/hay, since it is linked directly to the waste of young animals, especially calves. When comparing the loading data for *Cryptosporidium* with actual water quality data from research studies conducted by PWD, the data suggests that higher levels of *Cryptosporidium* are often caused by stormwater runoff during rain events, while daily concentrations observed in the Schuylkill River appear to be from NPDES discharges. Therefore, efforts to reduce mean daily concentrations of *Cryptosporidium* in the river should focus on reducing the impacts from wastewater discharges, while efforts to reduce peak concentrations should focus on mitigating stormwater runoff from pastures and developed areas.

Figure 3.1.3-2 Land Use Load Percentages and Loading by Source Type associated with *Cryptosporidium*





As shown in Figure 3.1.3-3 and Tables 3.1.3-3 and 3.1.3-4, high priority point sources for *Cryptosporidium* are located primarily along the mainstem of the Schuylkill River between Reading and Norristown, with a larger cluster of priority sources located just downstream of Norristown. One very high scoring site, the Upper Gywnedd-Towamencin Municipal Authority, is located off the mainstem within the Lower Perkiomen subwatershed. The Upper Gwynedd-Towamencin facility has an intake withdrawal weighting of approximately 73%, had a total of 25 discharge monitoring report violations between 1997 and 2003, and is located within the five hour time of travel of three drinking water intakes. Another high scoring source off the mainstem Schuylkill River is the Abington Township Community Waste Water Treatment Plant, located in the Wissahickon subwatershed. The Abington facility has a lower intake withdrawal weight than the Upper Gwynedd-Towamencin plant, but reported 51 DMRs during the same time period and is located within the five hour time of travel to PWD's Belmont and Queen Lane intakes. It should be noted that the Abington plant employs UV disinfection, which is not considered in the analysis but could be an effective barrier against *Cryptosporidium*.

The high priority non-point source subsheds are located in the Lower and Middle Schuylkill subwatersheds and in the Tulpehocken and Maiden Creek subwatersheds. The land uses in these areas are split with developed/urban lands in the lower portion of the Schuylkill watershed and around the City of Reading and agricultural uses within the Tulpehocken and Maiden Creek subwatersheds. The Schuylkill River-289 subshed in the area of Hamburg Borough and Windsor Townships scored very highly in this prioritization based upon the assumed loading concentrations for *Cryptosporidium*, the intake withdrawal weight of 78%, and the subshed's location within the five hour time of travel of three drinking water intakes. Similarly, the Tulpehocken subwatershed, located within the westernmost portion of the watershed in Lebanon County, scored very high due to heavy agricultural land uses throughout this area.

Figure 3.1.3-3 Priority Source Locations (*Cryptosporidium*)

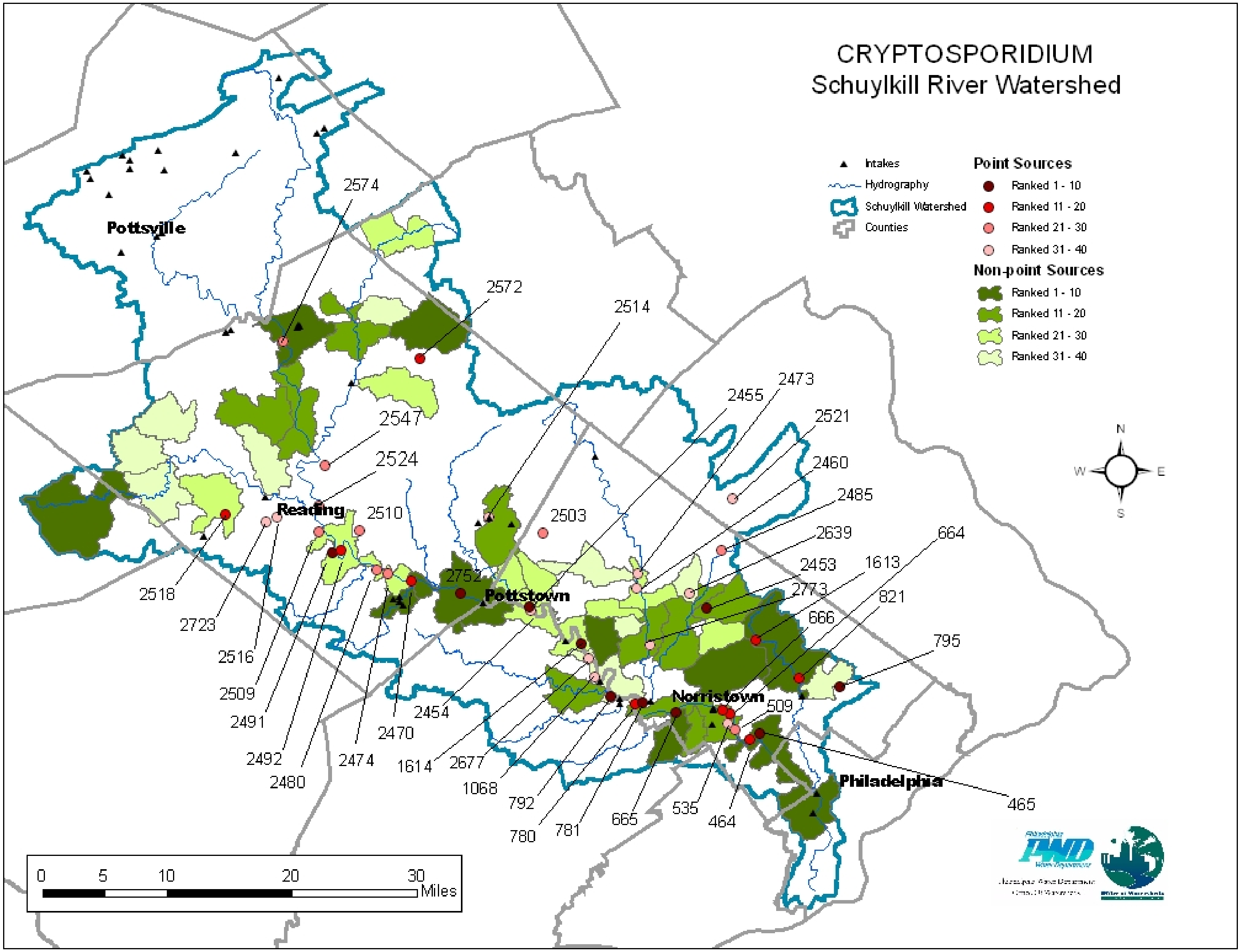


Table 3.1.3-3 Priority Point Source Locations for *Cryptosporidium* in the Schuylkill River Watershed

Source ID	Source Name	Crypto (oocysts/ day)	DMRs	Intake Weight (%)	Zone A	Score
781	MONTGOMERY COUNTY SEW AUTH	3.780E+07	218	67.50	2	1
665	UPPER MERION MUN UTILITY AUTH	3.780E+07	13	67.50	4	2
2455	POTTSTOWN BORO	3.780E+07	39	76.11	3	3
2453	UPPER GWYNEDD-TOWAMENCIN MUN	3.780E+07	25	73.29	3	4
792	PHOENIXVILL BORO STP	3.780E+07	6	73.29	3	5
2491	READING CITY	3.780E+07	92	78.29	1	6
465	WHITEMARSH TWP SEW AUTH	3.780E+07	72	62.95	2	7
2752	AMITY TOWNSHIP MUNICIPAL AUTH	3.780E+07	4	78.29	2	8
795	ABINGTON TWP COMM-WWTR TRTMT P	3.780E+07	51	62.95	2	9
1614	LIMERICK TWP MUN AUTH	3.780E+07	4	76.11	2	10
2492	GPU GENERATION INC TITUS GENERATING STATION	3.780E+07	36	78.29	1	11
780	VALLEY FORGE SEWER AUTHORITY	3.780E+07	12	67.50	2	12
666	NORRISTOWN MUN WASTE AUTH	3.780E+07	24	62.95	2	13
821	AMBLER BORO	3.780E+07	22	62.95	2	14
2518	ROBESONIA-WERNERSVILLE M/A OF	3.780E+07	20	80.00	1	15
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	3.780E+07	19	62.95	2	16
2470	BIRDSBORO BORO MUN AUTH	3.780E+07	18	78.29	1	17
464	CONSHOHOCKEN SEW TREAT. PLT.	3.780E+07	12	62.95	2	18
2572	KUTZTOWN MUN AUTH MUN SEW TREATMENT PLANT	3.780E+07	12	78.29	1	19
1613	UPPER GWYNEDD TWP	3.780E+07	61	62.95	1	20
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	3.780E+07	10	78.29	1	21
2474	EXETER TOWNSHIP WWTR TRTMT PLT	3.780E+07	8	78.29	1	22
509	LUKENS STEEL CO	3.780E+07	0	62.95	2	23
2547	NGK METALS CORP.	3.780E+07	47	78.29	0	24
2485	BOROUGH OF SOUDERTON	3.780E+07	6	73.29	1	25
2509	WYOMISSING VALLEY JOINT MUN AU	3.780E+07	37	78.29	0	26
2574	HAMBURG MUN AUTH	3.780E+07	25	78.29	0	27
2503	BERKS MONTGOMERY MUNICIPAL AUTH	3.780E+07	29	73.29	0	28
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	3.780E+07	9	78.29	0	29
2524	CARPENTER TECHNOLOGY CORP	3.780E+07	8	78.29	0	30
2516	SPRING TWP MUN AUTH	3.780E+07	5	78.29	0	31
2723	SINKING SPRING BORO MUN AUTH	3.780E+07	0	78.29	0	32
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	3.780E+07	0	73.29	0	33
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	3.780E+07	4	66.16	0	34
1068	PECO ENERGY CO-CROMBY	3.780E+06	0	74.51	4	35

Source ID	Source Name	Crypto (oocysts/ day)	DMRs	Intake Weight (%)	Zone A	Score
	GENERATING					
2677	SPRING CITY BOROUGH SEWAGE PLANT	3.780E+06	0	74.51	4	35
2514	BOYERTOWN BORO	3.780E+06	0	76.38	3	37
2454	NORTH COVENTRY MUN AUTH STP	3.780E+06	0	76.11	3	38
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	3.780E+06	0	73.29	3	39
2473	LOWER FREDERICK TOWNSHIP TRT P	3.780E+06	0	73.29	3	39
2639	LOWER SALFORD TWP AUTH	3.780E+06	0	73.29	3	39
2460	SCHWENKSVILLE BOROUGH AUTH	3.780E+06	0	73.29	3	39

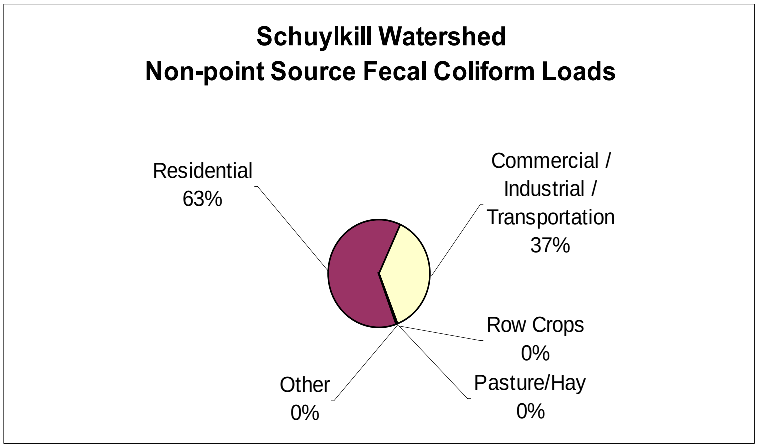
Table 3.1.3-4 Priority Non-Point Source Locations for *Cryptosporidium* in the Schuylkill River Watershed

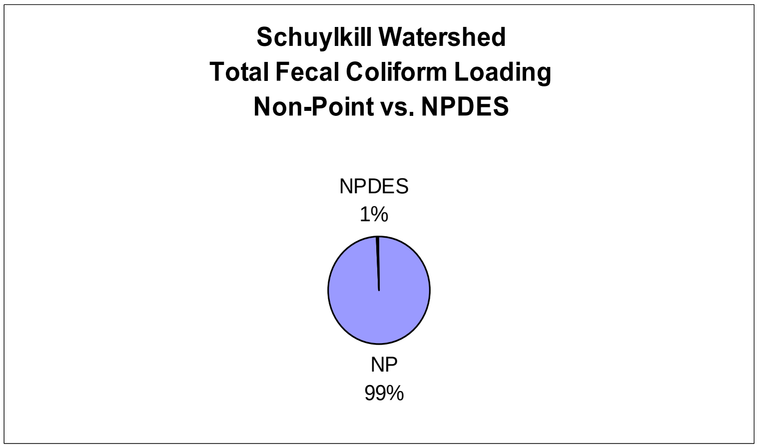
Source ID	Source Name	Crypto (oocysts/ day)	Intake Weight (%)	Zone A	Score
90236	Tulpehocken Creek-236	1.55E+08	80.00	0	1
90289	Schuylkill River-289	8.12E+07	78.33	3	2
90024	Stony Creek-024	9.20E+07	65.23	3	3
90008	Wissahickon Creek-008	1.17E+08	62.95	2	4
90027	Trout Creek-027	4.08E+07	67.50	4	5
90190	Hay Creek-190	4.94E+06	78.50	5	6
90003	Schuylkill River-003	1.70E+08	26.05	0	7
90164	Schuylkill River-164	4.89E+07	76.11	3	8
90265	Mill Creek-265	9.31E+07	78.29	1	9
90153	Mingo Creek-153	2.38E+07	74.51	4	10
90283	Irish Creek-283	1.08E+08	78.29	0	11
90025	Crow Creek-025	2.01E+07	67.50	4	12
90282	Schuylkill River-282	1.04E+08	78.29	0	13
90020	Schuylkill River-020	7.00E+07	62.95	2	14
90135	French Creek-135	3.64E+07	73.29	3	15
90045	Towamencin Creek-045	3.44E+07	73.29	3	16
90042	Skippack Creek-042	3.24E+07	73.29	3	17
90267	Maiden Creek-267	7.49E+07	78.29	1	18
90049	Perkiomen Creek-049	2.88E+07	73.29	3	19
90167	Ironstone Creek-167	2.56E+07	76.29	3	20
90154	Schuylkill River-154	4.74E+07	74.51	2	21
90193	Schuylkill River-193	6.63E+07	78.29	1	22
90165	Manatawny Creek-165	1.97E+07	76.11	3	23
90044	Zacharias Creek-044	2.03E+07	73.29	3	24
90277	Ontelaunee Creek-277	8.68E+07	78.29	0	25
90163	Sprogles Run-163	1.70E+07	76.11	3	26
90248	Moselem Creek-248	6.22E+07	78.29	1	27
90051	Lodal Creek-051	1.81E+07	73.29	3	28
90213	Spring Creek-213	8.09E+07	80.00	0	29
90052	Perkiomen Creek-052	1.57E+07	73.29	3	30
90105	Schuylkill River-105	3.77E+07	73.29	2	31
90224	Little Northkill Creek-224	7.86E+07	80.00	0	32
90046	West Branch Skippack Creek-046	1.36E+07	73.29	3	33
90209	Plum Creek-209	8.00E+07	78.29	0	34
90065	Swamp Creek-065	1.24E+07	73.29	3	35
90233	Mill Creek-233	7.71E+07	80.00	0	36
90009	Sandy Run-009	4.35E+07	62.95	2	37
90050	Schoolhouse Run-050	9.42E+06	73.29	3	38
90269	Maiden Creek-269	5.17E+07	78.29	1	39
90234	Tulpehocken Creek-234	7.34E+07	80.00	0	40

Fecal Coliform

As seen in Figure 3.1.3-4, fecal coliform is primarily associated with stormwater runoff from developed land areas. Disinfection of sewage treatment plant effluent is so effective at killing fecal coliforms that the relative load is minimal compared to that of stormwater runoff. However, coliforms can originate from a number of other sources that are more difficult to quantify including leaking septic tanks, leaking sewers, "wildcat" or illegal sewer discharges, geese, and livestock.

Figure 3.1.3-4 Land Use Load Percentages and Loading by Source Type associated with Fecal Coliform





As shown in Figure 3.1.3-5 and Tables 3.1.3-5 and 3.1.3-6, high priority point sources for fecal coliform show a very similar pattern to priority sources for *Cryptosporidium*. They are located primarily along the mainstem of the Schuylkill River between Reading and Norristown, with a larger cluster of priority sources located just downstream of Norristown. Again, the Abington Township Community Wastewater Treatment Plant in the Wissahickon subwatershed scored very highly due to its location within the five hour time of travel to the PWD's Belmont and Queen Lane intakes and the 51 discharge monitoring report violations on record between 1997 and 2003. Another high scoring site, the Kutztown Sewage Treatment Plant, is located off the mainstem within the Maiden Creek subwatershed. The Kutztown facility has an intake withdrawal weighting of approximately 78%, had a total of 12 discharge monitoring report violations between 1997 and 2003, and is located within the five hour time of travel of the Reading Area Water Authority intake.

The high priority subsheds are located primarily in the lower portion of the watershed in the Lower, Middle, and Wissahickon subwatersheds. The exception is the Schuylkill River-289 subshed in the area of Hamburg Borough and Windsor Townships, which scored very highly in this prioritization based upon the loading results for fecal coliform, the intake withdrawal weight of 78%, and the subsheds' locations within the five hour time of travel of three drinking water intakes.

Again the areas within the Lower Perkiomen subwatershed scored high within this prioritization. The Perkiomen Creek subwatershed includes substantial agricultural land use activities; however development pressure in this area increased the fecal coliform loadings, which is connected with developed land areas. As previously stated, this is an area of particular concern due to increased population over the past decade.

Figure 3.1.3-5 Priority Source Locations (Fecal Coliform)

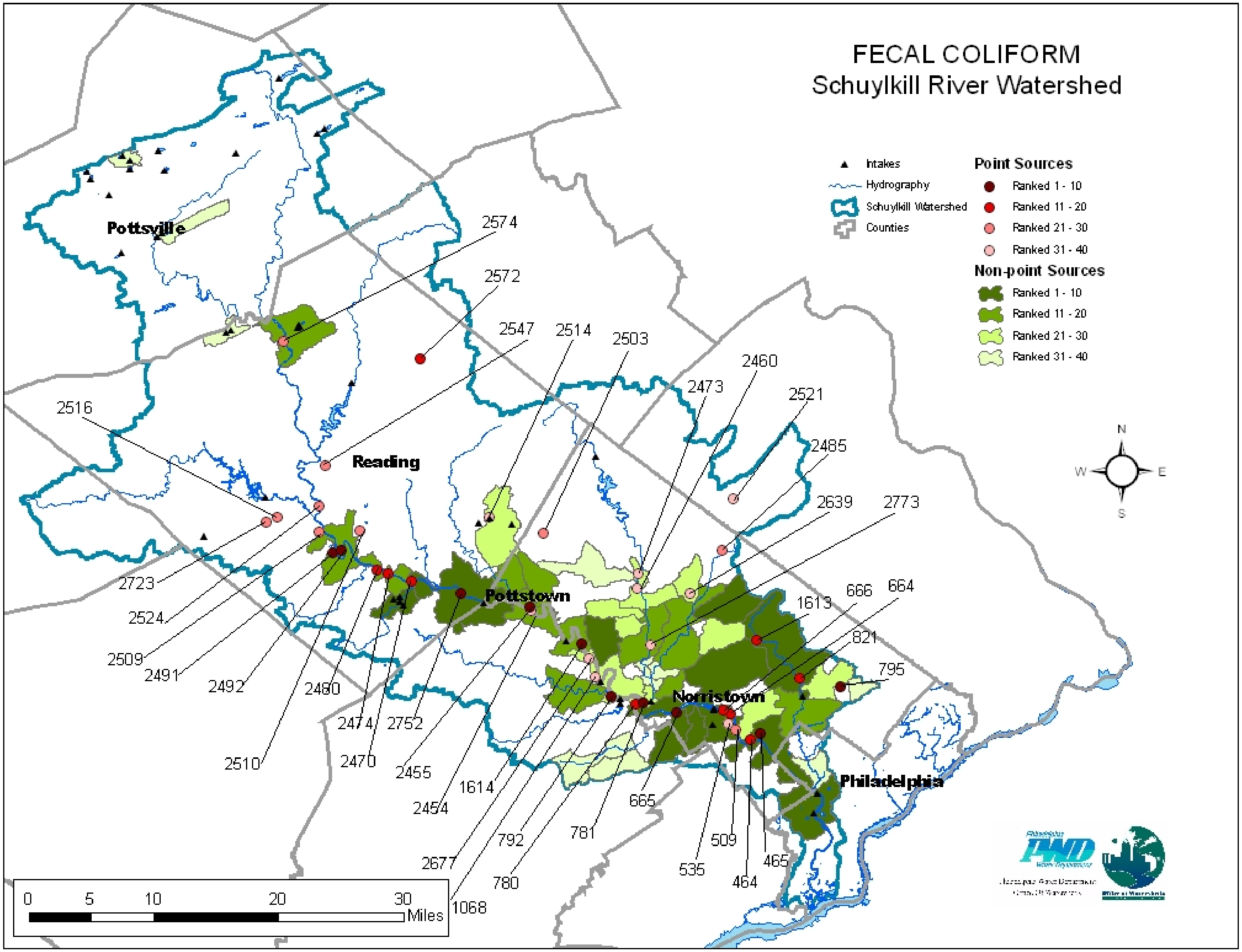


Table 3.1.3-5 Priority Point Source Locations for Fecal Coliform in the Schuylkill River Watershed

Source ID	Source Name	Fecal Coliform (col/day)	DMRs	Intake Weight (%)	Zone A	Score
781	MONTGOMERY COUNTY SEW AUTH	7.560E+08	218	67.50	2	1
665	UPPER MERION MUN UTILITY AUTH	7.560E+08	13	67.50	4	2
2455	POTTSTOWN BORO	7.560E+08	39	76.11	3	3
792	PHOENIXVILL BORO STP	7.560E+08	6	73.29	3	4
2491	READING CITY	7.560E+08	92	78.29	1	5
465	WHITEMARSH TWP SEW AUTH	7.560E+08	72	62.95	2	6
2752	AMITY TOWNSHIP MUNICIPAL AUTH	7.560E+08	4	78.29	2	7
795	ABINGTON TWP COMM-WWTR TRTMT P	7.560E+08	51	62.95	2	8
1614	LIMERICK TWP MUN AUTH	7.560E+08	4	76.11	2	9
2492	GPU GENERATION INC TITUS GENERATING STATION	7.560E+08	36	78.29	1	10
780	VALLEY FORGE SEWER AUTHORITY	7.560E+08	12	67.50	2	11
666	NORRISTOWN MUN WASTE AUTH	7.560E+08	24	62.95	2	12
821	AMBLER BORO	7.560E+08	22	62.95	2	13
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	7.560E+08	19	62.95	2	14
2470	BIRDSBORO BORO MUN AUTH	7.560E+08	18	78.29	1	15
464	CONSHOHOCKEN SEW TREAT. PLT.	7.560E+08	12	62.95	2	16
2572	KUTZTOWN MUN AUTH MUN SEW TREATMENT PLANT	7.560E+08	12	78.29	1	17
1613	UPPER GWYNEDD TWP	7.560E+08	61	62.95	1	18
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	7.560E+08	10	78.29	1	19
2474	EXETER TOWNSHIP WWTR TRTMT PLT	7.560E+08	8	78.29	1	20
509	LUKENS STEEL CO	7.560E+08	0	62.95	2	21
2547	NGK METALS CORP.	7.560E+08	47	78.29	0	22
2485	BOROUGH OF SOUDERTON	7.560E+08	6	73.29	1	23
2509	WYOMISSING VALLEY JOINT MUN AU	7.560E+08	37	78.29	0	24
2574	HAMBURG MUN AUTH	7.560E+08	25	78.29	0	25
2503	BERKS MONTGOMERY MUNICIPAL AUTH	7.560E+08	29	73.29	0	26
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	7.560E+08	9	78.29	0	27
2524	CARPENTER TECHNOLOGY CORP	7.560E+08	8	78.29	0	28
2516	SPRING TWP MUN AUTH	7.560E+08	5	78.29	0	29
2723	SINKING SPRING BORO MUN AUTH	7.560E+08	0	78.29	0	30
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	7.560E+08	0	73.29	0	31
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	7.560E+08	4	66.16	0	32
1068	PECO ENERGY CO-CROMBY GENERATING	7.560E+07	0	74.51	4	33

Source ID	Source Name	Fecal Coliform (col/day)	DMRs	Intake Weight (%)	Zone A	Score
2677	SPRING CITY BOROUGH SEWAGE PLANT	7.560E+07	0	74.51	4	33
2514	BOYERTOWN BORO	7.560E+07	0	76.38	3	35
2454	NORTH COVENTRY MUN AUTH STP	7.560E+07	0	76.11	3	36
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	7.560E+07	0	73.29	3	37
2473	LOWER FREDERICK TOWNSHIP TRT P	7.560E+07	0	73.29	3	37
2639	LOWER SALFORD TWP AUTH	7.560E+07	0	73.29	3	37
2460	SCHWENKSVILLE BOROUGH AUTH	7.560E+07	0	73.29	3	37

Table 3.1.3-6 Priority Non-Point Source Locations for Fecal Coliform in the Schuylkill River Watershed

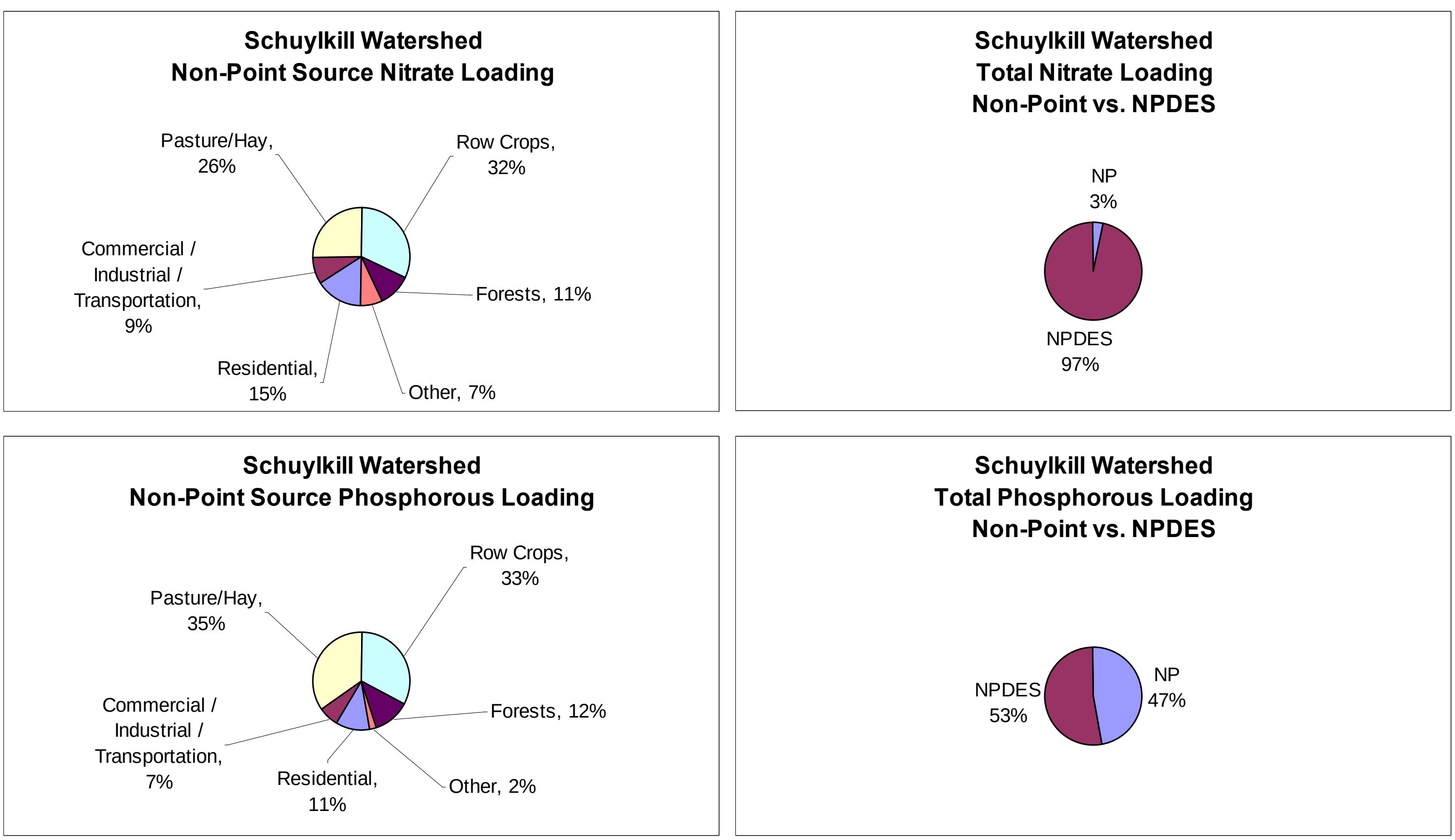
Source ID	Source Name	Fecal Coliform (col/day)	Intake Weight (%)	Zone A	Score
90024	Stony Creek-024	4.27E+12	65.23	3	1
90008	Wissahickon Creek-008	5.22E+12	62.95	2	2
90027	Trout Creek-027	2.32E+12	67.50	4	3
90190	Hay Creek-190	2.09E+11	78.50	5	4
90003	Schuylkill River-003	9.32E+12	26.05	0	5
90025	Crow Creek-025	1.27E+12	67.50	4	6
90153	Mingo Creek-153	6.88E+11	74.51	4	7
90045	Towamencin Creek-045	2.02E+12	73.29	3	8
90164	Schuylkill River-164	1.68E+12	76.11	3	9
90020	Schuylkill River-020	3.61E+12	62.95	2	10
90135	French Creek-135	1.43E+12	73.29	3	11
90289	Schuylkill River-289	1.01E+12	78.33	3	12
90049	Perkiomen Creek-049	1.06E+12	73.29	3	13
90042	Skippack Creek-042	9.26E+11	73.29	3	14
90163	Sprogles Run-163	7.75E+11	76.11	3	15
90165	Manatawny Creek-165	7.49E+11	76.11	3	16
90007	Wissahickon Creek-007	2.63E+12	62.95	2	17
90154	Schuylkill River-154	1.89E+12	74.51	2	18
90039	Mine Run-039	5.83E+11	73.29	3	19
90193	Schuylkill River-193	2.88E+12	78.29	1	20
90009	Sandy Run-009	2.34E+12	62.95	2	21
90052	Perkiomen Creek-052	4.63E+11	73.29	3	22
90167	Ironstone Creek-167	2.74E+11	76.29	3	23
90046	West Branch Skippack Creek-046	3.66E+11	73.29	3	24
90051	Lodal Creek-051	3.55E+11	73.29	3	25
90105	Schuylkill River-105	1.65E+12	73.29	2	26
90044	Zacharias Creek-044	3.04E+11	73.29	3	27
90038	Perkiomen Creek-038	2.91E+11	73.29	3	28
90018	Plymouth Creek-018	2.12E+12	62.95	2	29
90050	Schoolhouse Run-050	2.77E+11	73.29	3	30
90040	Perkiomen Creek-040	2.59E+11	73.29	3	31
90041	Skippack Creek-041	2.11E+11	73.29	3	32
90065	Swamp Creek-065	1.12E+11	73.29	3	33
90034	Little Valley Creek-034	1.62E+12	67.50	2	34
90035	Valley Creek-035	1.43E+12	67.50	2	35
90012	Sandy Run-012	1.49E+12	62.95	2	36
90004	Wissahickon Creek-004	1.45E+12	62.95	2	37
90321	Mud Run-321	3.60E+11	78.87	2	38
90316	Tumbling Run-316	1.70E+10	79.24	2	39
90291	Stony Creek-291	1.31E+09	78.31	2	40

Nutrients (Nitrate & Phosphorus)

A water quality analysis shows that nitrate and ammonia concentrations are decreasing in the river. Also, seasonal fluctuations in nitrate concentrations appear to be dominated by biological activity in the river. However, a separate analysis of the 303(d) impaired stream reach data suggests that nutrients are one of the top three leading causes of impairments in the lower half of the Schuylkill River watershed. Upon further examination, these impairments may be more related to phosphorus than nitrate. Overall, the combined information suggests that improvements to wastewater discharge and reduced agricultural runoff have benefited the watershed, but the cumulative impacts of nitrate and phosphorus from both point and non-point sources combined may still play a significant role in determining stream health.

"Nutrients" within this prioritization include the priority sources for nitrate and phosphorus from the source water assessments. In some cases, the sources are highly ranked as a priority for both nitrate and phosphorus. These sources were weighted heavier in the final prioritization than sources which include only one parameter. As seen in Figure 3.1.3-6, nitrate and phosphorus are both associated primarily with agricultural lands uses and runoff, although both nitrate and phosphorus are attributed to a greater degree to point sources than non-point sources.

Figure 3.1.3-6 Land Use Load Percentages and Loading by Source Type associated with Nutrients



As shown in Figure 3.1.3-7 and Tables 3.1.3-7 and 3.1.3-8, high priority point sources for nutrients are located along the mainstem of the Schuylkill River between Reading and Norristown, and within the Lower Perkiomen and Wissahickon subwatersheds. The Upper Gwynedd-Towamencin Municipal Authority and Lower Salford Township Authority wastewater treatment plants, located in the Lower Perkiomen subwatershed, scored highly in this prioritization based upon their similar intake withdrawal weight of approximately 73% and the location of three intakes within a five hour time of travel. The Upper Gwynedd-Towamencin Municipal Authority also has high effluent nutrient concentrations and 25 discharge monitoring report violations on record. Similarly, the Abington Township Community Waste Water Treatment Plant in the Wissahickon subwatershed scored highly due to its high effluent concentration of nitrate, and 51 DMR violations on record, even though the source has a lower intake withdrawal weight of 63%.

The high priority subsheds are located primarily in the Lower Perkiomen, Tulpehocken, and Maiden Creek subwatersheds. Since nutrients are associated primarily with agricultural land uses, as seen in Figure 3.1.3-6 above, it makes sense that these subsheds would score as the highest protection priority for nutrients since the majority of the watershed's agricultural activities occur in these areas. Again, the areas of Hamburg Borough and Windsor Township scored highly in this prioritization based upon the loading results for nitrate, the intake withdrawal weight of 78%, and the subsheds' locations within the five hour time of travel of three drinking water intakes.

Figure 3.1.3-7 Priority Source Locations (Nutrients)

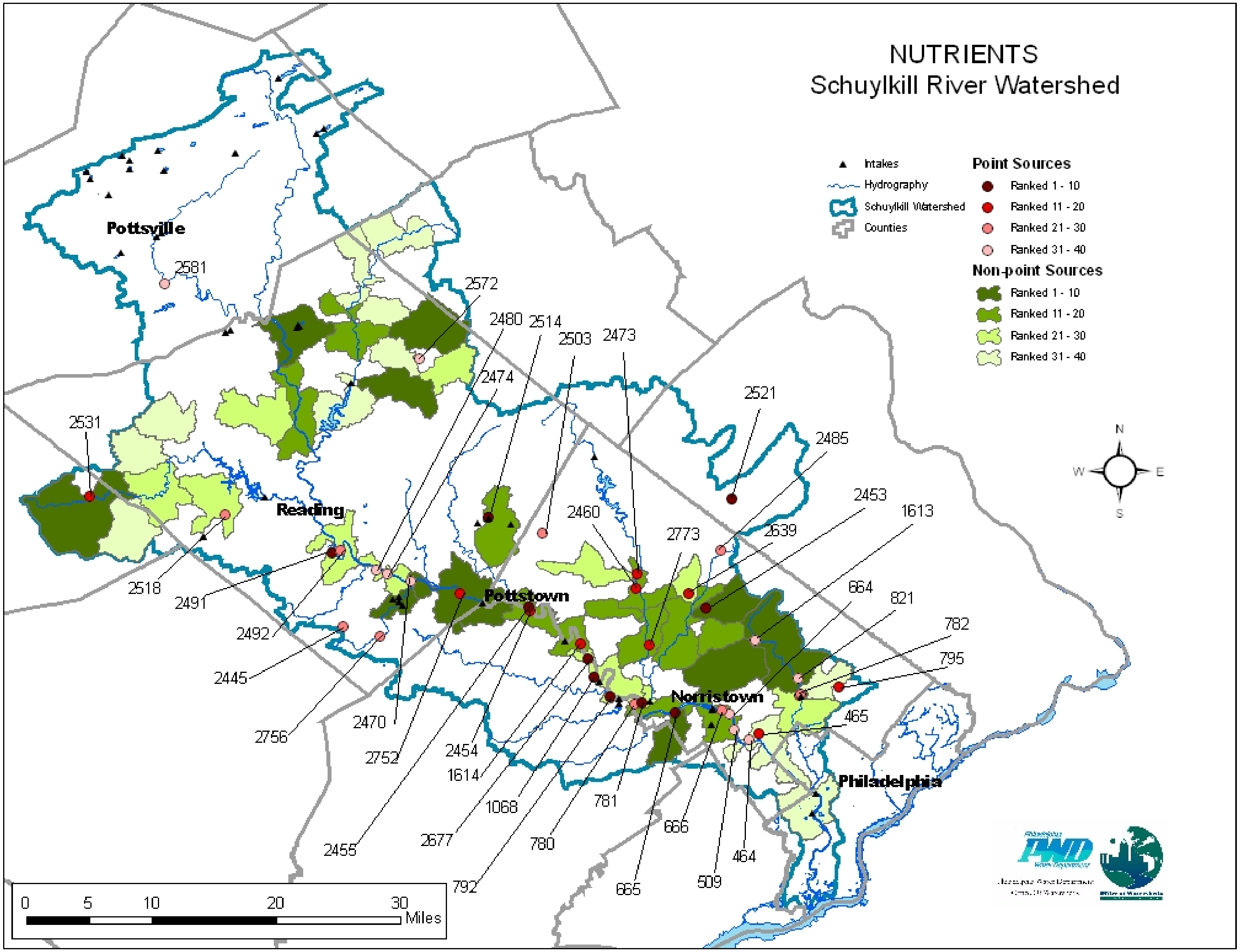


Table 3.1.3-7 Priority Point Source Locations for Nutrients in the Schuylkill River Watershed

Source ID	Source Name	Nitrate (lbs./day)	Phosphorus (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
2453	UPPER GWYNEDD-TOWAMENCIN MUN	1.127E+03	1.420E+02	25	73.29	3	1
2491	READING CITY	1.172E+05	1.080E+01	92	78.29	1	2
781	MONTGOMERY COUNTY SEW AUTH	2.815E+03	1.080E+01	218	67.50	2	3
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	8.064E+03	1.160E+02	0	73.29	0	4
665	UPPER MERION MUN UTILITY AUTH	3.514E+03	1.080E+01	13	67.50	4	5
2455	POTTSTOWN BORO	1.300E+03	1.080E+01	39	76.11	3	6
1068	PECO ENERGY CO-CROMBY GENERATING	7.200E+00	1.668E+00	0	74.51	4	7
2677	SPRING CITY BOROUGH SEWAGE PLANT	7.200E+00	1.668E+00	0	74.51	4	7
792	PHOENIXVILL BORO STP	1.930E+03	1.080E+01	6	73.29	3	9
2514	BOYERTOWN BORO	7.200E+00	1.668E+00	0	76.38	3	10
2454	NORTH COVENTRY MUN AUTH STP	7.200E+00	1.668E+00	0	76.11	3	11
465	WHITEMARSH TWP SEW AUTH	1.476E+03	1.080E+01	72	62.95	2	12
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	7.200E+00	1.668E+00	0	73.29	3	13
2473	LOWER FREDERICK TOWNSHIP TRT P	7.200E+00	1.668E+00	0	73.29	3	13
2639	LOWER SALFORD TWP AUTH	7.200E+00	1.668E+00	0	73.29	3	13
2460	SCHWENKSVILLE BOROUGH AUTH	7.200E+00	1.668E+00	0	73.29	3	13
2531	MYERSTOWN STP	3.636E+02	2.274E+01	31	80.00	1	17
795	ABINGTON TWP COMM-WWTR TRTMT P	2.380E+03	1.080E+01	51	62.95	2	18
2752	AMITY TOWNSHIP MUNICIPAL AUTH	1.152E+02	1.080E+01	4	78.29	2	19
1614	LIMERICK TWP MUN AUTH	9.000E+01	1.080E+01	4	76.11	2	20
2485	BOROUGH OF SOUDERTON	2.311E+02	3.720E+01	6	73.29	1	21
666	NORRISTOWN MUN WASTE AUTH	4.918E+03	1.080E+01	24	62.95	2	22
783	AMBLER BOROUGH WATER DEPT	7.200E+00	1.668E+00	0	63.16	3	23
782	PENN HISTORICAL & MUSEUM COMM	7.200E+00	1.668E+00	0	63.16	3	23
780	VALLEY FORGE SEWER AUTHORITY	2.669E+03	1.080E+01	12	67.50	2	25
2518	ROBESONIA-WERNERSVILLE M/A OF	1.282E+02	1.642E+01	20	80.00	1	26
2492	GPU GENERATION INC TITUS GENERATING STATION	9.666E+01	1.080E+01	36	78.29	1	27
2503	BERKS MONTGOMERY MUNICIPAL AUTH	1.130E+03	4.540E+01	29	73.29	0	28
2756	HIGH POINT BAPTIST CHAPEL	7.200E+00	1.668E+00	0	78.34	2	29
2445	POST OFFICE INN CORP	7.200E+00	1.668E+00	0	78.34	2	29
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	2.243E+03	1.080E+01	19	62.95	2	31
821	AMBLER BORO	4.374E+02	1.080E+01	22	62.95	2	32
2581	SCHUYLKILL HAVEN MUN AUTH-STP	6.552E+02	1.080E+01	79	78.29	0	33

Source ID	Source Name	Nitrate (lbs./day)	Phosphorus (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
2470	BIRDSBORO BORO MUN AUTH	1.328E+03	1.080E+01	18	78.29	1	34
464	CONSHOHOCKEN SEW TREAT. PLT.	7.128E+02	1.080E+01	12	62.95	2	35
2572	KUTZTOWN MUN AUTH MUN SEW TREATMENT PLANT	5.418E+02	1.080E+01	12	78.29	1	36
1613	UPPER GWYNEDD TWP	2.952E+02	1.080E+01	61	62.95	1	37
2474	EXETER TOWNSHIP WWTR TRTMT PLT	1.845E+03	1.080E+01	8	78.29	1	38
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	1.638E+02	1.080E+01	10	78.29	1	39
509	LUKENS STEEL CO	9.666E+01	1.080E+01	0	62.95	2	40

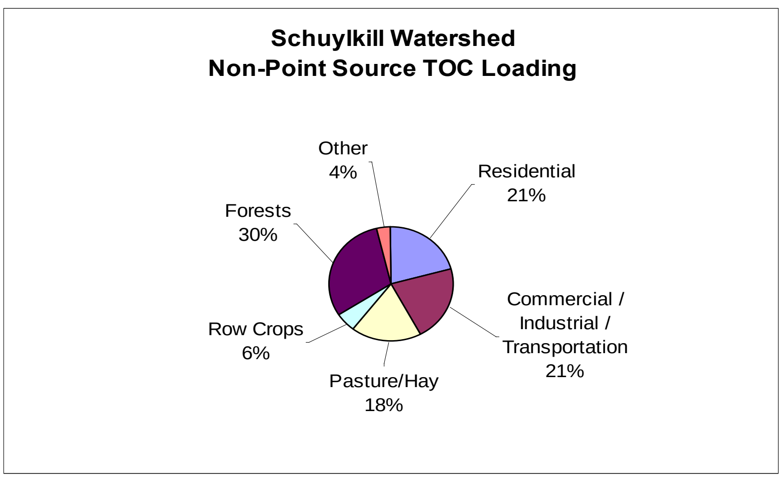
Table 3.1.3-8 Priority Non-Point Source Locations (Nutrients)

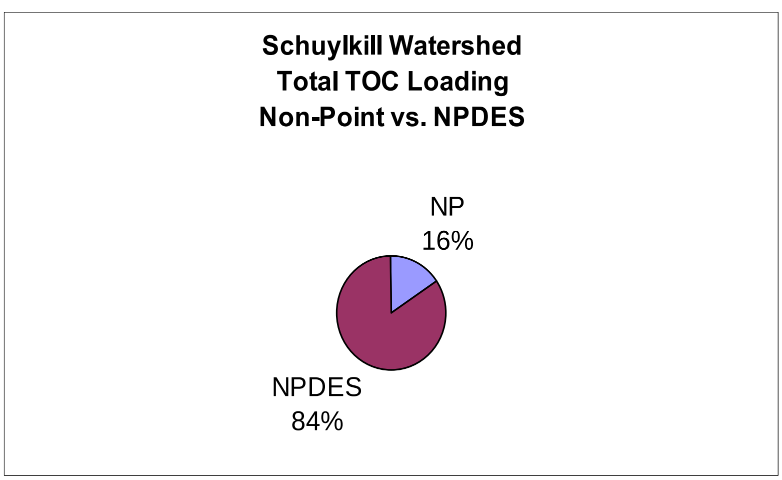
Source ID	Source Name	Nitrate (lbs./day)	Phosphorus (lbs./day)	Intake Weight (%)	Zone A	Score
90236	Tulpehocken Creek-236	2.351E+02	4.592E+01	80.00	0	1
90289	Schuylkill River-289	8.868E+01	1.642E+01	78.33	3	2
90024	Stony Creek-024	1.090E+02	1.675E+01	65.23	3	3
90190	Hay Creek-190	6.566E+00	9.952E-01	78.50	5	4
90008	Wissahickon Creek-008	1.355E+02	2.074E+01	62.95	2	5
90265	Mill Creek-265	1.264E+02	2.591E+01	78.29	1	6
90027	Trout Creek-027	4.978E+01	6.587E+00	67.50	4	7
90164	Schuylkill River-164	5.751E+01	8.318E+00	76.11	3	8
90248	Moselem Creek-248	9.933E+01	1.973E+01	78.29	1	9
90045	Towamencin Creek-045	4.112E+01	5.869E+00	73.29	3	10
90042	Skippack Creek-042	3.239E+01	5.636E+00	73.29	3	11
90049	Perkiomen Creek-049	3.033E+01	4.674E+00	73.29	3	12
90167	Ironstone Creek-167	2.240E+01	4.497E+00	76.29	3	13
90020	Schuylkill River-020	8.839E+01	1.034E+01	62.95	2	14
90044	Zacharias Creek-044	1.971E+01	3.825E+00	73.29	3	15
90267	Maiden Creek-267	7.580E+01	1.583E+01	78.29	1	16
90051	Lodal Creek-051	1.769E+01	3.250E+00	73.29	3	17
90282	Schuylkill River-282	1.091E+02	2.063E+01	78.29	0	18
90154	Schuylkill River-154	5.407E+01	7.284E+00	74.51	2	19
90052	Perkiomen Creek-052	1.545E+01	2.578E+00	73.29	3	20
90283	Irish Creek-283	1.005E+02	2.160E+01	78.29	0	21
90046	West Branch Skippack Creek-046	1.243E+01	2.204E+00	73.29	3	22
90065	Swamp Creek-065	1.081E+01	2.214E+00	73.29	3	23
90038	Perkiomen Creek-038	8.662E+00	9.368E-01	73.29	3	24
90105	Schuylkill River-105	4.639E+01	5.952E+00	73.29	2	25
90007	Wissahickon Creek-007	6.029E+01	8.229E+00	62.95	2	26
90234	Tulpehocken Creek-234	9.259E+01	1.878E+01	80.00	0	27
90213	Spring Creek-213	9.158E+01	1.859E+01	80.00	0	28
90193	Schuylkill River-193	7.451E+01	9.568E+00	78.29	1	29
90256	Sacony Creek-256	9.392E+01	1.834E+01	78.29	0	30
90009	Sandy Run-009	5.505E+01	7.953E+00	62.95	2	31
90277	Ontelaunee Creek-277	9.102E+01	1.878E+01	78.29	0	32
90224	Little Northkill Creek-224	8.718E+01	1.829E+01	80.00	0	33
90271	Maiden Creek-271	5.226E+01	1.116E+01	78.29	1	34
90003	Schuylkill River-003	1.895E+02	2.370E+01	26.05	0	35
90245	Maiden Creek-245	1.002E+02	1.587E+01	74.79	0	36
90252	Sacony Creek-252	4.936E+01	1.001E+01	78.29	1	37
90269	Maiden Creek-269	4.593E+01	9.887E+00	78.29	1	38
90233	Mill Creek-233	7.479E+01	1.607E+01	80.00	0	39
90235	Mill Creek-235	7.539E+01	1.500E+01	80.00	0	40

Total Organic Carbon (Disinfection By-Product Precursor)

Total Organic Carbon (TOC) can come from many sources, including agriculture, decaying leaves and algae, and sewage discharge. TOC can be an indicator of disinfection by-product formation potential, which is a concern for drinking water systems that disinfect with chlorination. The nature of the organic matter from various sources can be significantly different and have different impacts on the formation of disinfection by-products when reacting with chlorine. This analysis does not take these differences into account and therefore only provides an initial, broad look at disinfection by-product precursors. Water quality data suggest that TOC has increased in the river over the past decade. Since the population in the watershed has not changed significantly in the past decade, it is doubtful that NPDES discharges are the cause of this increase. However, during this period developed land throughout the watershed has increased. These observations suggest that the combined impact from the many non-point sources in the watershed, such as increased cars, fuel, and oil, may be driving the increasing TOC concentrations observed in the river. Figure 3.1.3-8 shows the land use loadings for TOC in the Schuylkill River watershed.

Figure 3.1.3-8 Land Use Load Percentages and Loading by Source Type associated with Total Organic Carbon





As shown in Figure 3.1.3-9 and Tables 3.1.3-9 and 3.1.3-10, high priority point sources for TOC are located primarily along the mainstem of the lower Schuylkill River between Pottstown and Norristown and within the Wissahickon and Lower Perkiomen subwatersheds. The Greater Pottsville Area Sewer Authority and the Schuylkill Haven Sewage Treatment Plant located in the Upper Schuylkill subwatershed also scored very high in this prioritization. Both sources have the same intake withdrawal weight of 78% and no drinking water sources within a five hour time of travel. However, the Greater Pottsville facility reported very high loadings for TOC, and has 54 discharge monitoring report violations on record between 1997 and 2003. The Schuylkill Haven Sewage Treatment Plant also reported rather high concentrations of TOC and has 79 DMR violations during this same time period. The Upper Gwynedd Township Authority in the Wissahickon subwatershed also scored very high in this prioritization. This potential source has one of the lower intake withdrawal weights of 62% and one intake within a five hour time of travel (PWD's Queen Lane intake). However, the Upper Gywnedd Township Authority reported high effluent TOC concentrations and has 61 DMR violations on record between 1997 and 2003.

The highest priority subsheds for TOC are concentrated within the Lower Schuylkill, Wissahickon, and Lower Perkiomen subwatersheds, with the exception of the areas within Hamburg Borough and Windsor Townships in the Upper Schuylkill subwatershed. The Maiden Creek subwatershed scored as a moderate priority in this analysis. TOC is associated with both developed and agricultural land uses; therefore, subsheds that are either highly developed or used primarily for agriculture, scored highest in this prioritization. Although NPDES wastewater dischargers generally have a high impact on TOC loadings, population growth has stabilized in the region while development continues to increase. Therefore, protection efforts should be focused on non-point sources. Municipalities of particular concern include Skippack, Worcester, West Norriton, East Norriton, Whitpain, Ambler, Lower Gwynedd, Upper Gwynedd, North Wales, Towamencin, and Phoenixville. Municipal officials should take care to ensure that proper stormwater ordinances are in place throughout these areas to protect against the impacts of increased development.

Figure 3.1.3-9 Priority Source Locations (Total Organic Carbon)

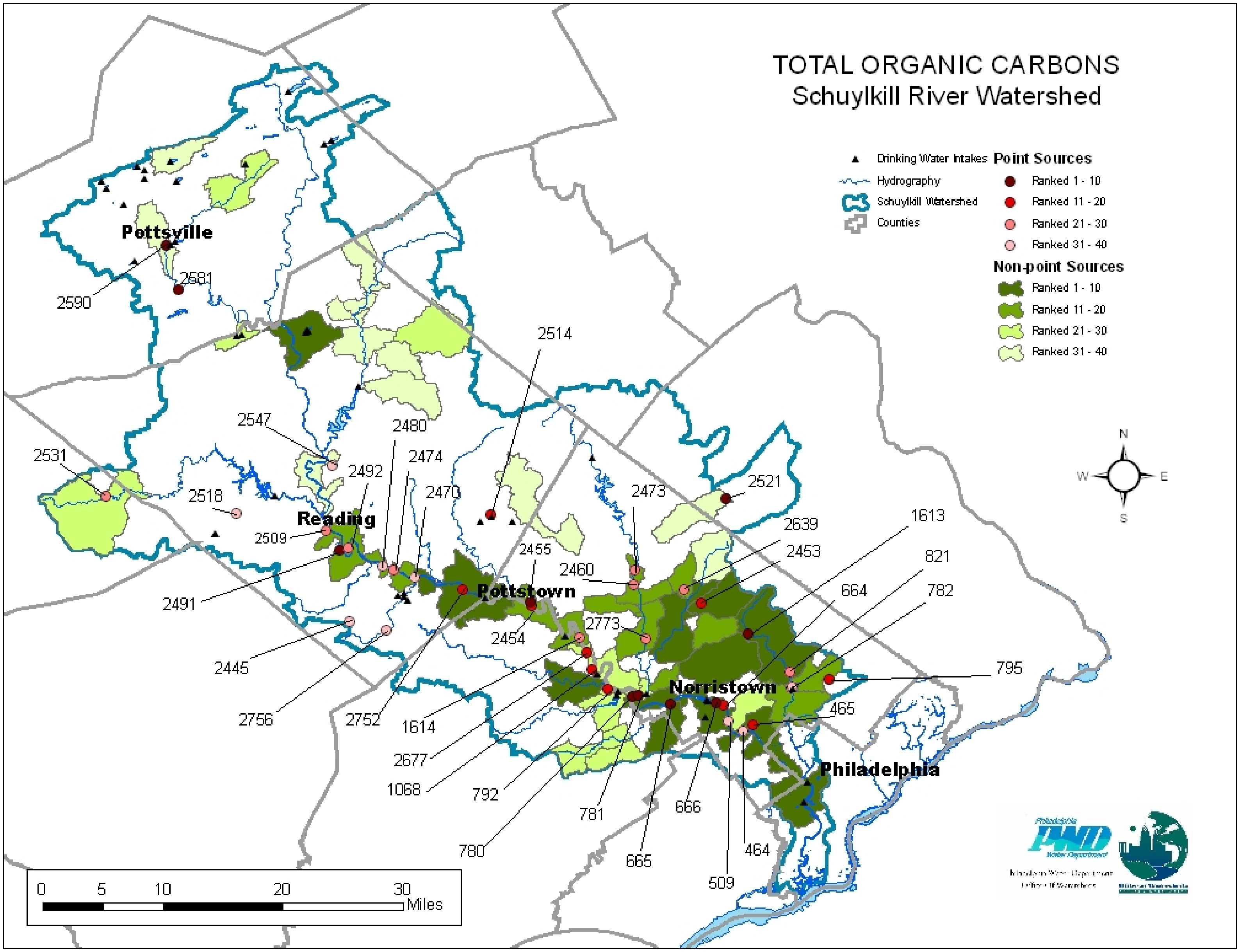


Table 3.1.3-9 Priority Point Source Locations for Total Organic Carbon in the Schuylkill River Watershed

Source ID	Source Name	TOC (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
2491	READING CITY	7.262E+03	92	78.29	1	1
2590	GREATER POTTSVILLE AREA SEW AUTH	7.153E+03	54	78.29	0	2
2455	POTTSTOWN BORO	5.085E+03	39	76.11	3	3
781	MONTGOMERY COUNTY SEW AUTH	3.540E+03	218	67.50	2	4
1613	UPPER GWYNEDD TWP	4.145E+03	61	62.95	1	5
666	NORRISTOWN MUN WASTE AUTH	3.078E+03	24	62.95	2	6
2581	SCHUYLKILL HAVEN MUN AUTH-STP	2.668E+03	79	78.29	0	7
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	3.677E+03	0	73.29	0	8
665	UPPER MERION MUN UTILITY AUTH	1.086E+03	13	67.50	4	9
780	VALLEY FORGE SEWER AUTHORITY	2.194E+03	12	67.50	2	10
792	PHOENIXVILL BORO STP	1.206E+03	6	73.29	3	11
465	WHITEMARSH TWP SEW AUTH	1.458E+03	72	62.95	2	12
795	ABINGTON TWP COMM-WWTR TRTMT P	1.617E+03	51	62.95	2	13
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	1.973E+03	19	62.95	2	14
2453	UPPER GWYNEDD-TOWAMENCIN MUN	7.436E+02	25	73.29	3	15
1068	PECO ENERGY CO-CROMBY GENERATING	3.970E+01	0	74.51	4	16
2677	SPRING CITY BOROUGH SEWAGE PLANT	3.970E+01	0	74.51	4	16
2752	120 OLD PHILADELPHI	9.782E+02	4	78.29	2	18
2454	NORTH COVENTRY MUN AUTH STP	8.655E+01	0	76.11	3	19
2514	BOYERTOWN BORO	3.970E+01	0	76.38	3	20
2531	MYERSTOWN STP	7.373E+02	31	80.00	1	21
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	3.970E+01	0	73.29	3	22
2473	LOWER FREDERICK TOWNSHIP TRT P	3.970E+01	0	73.29	3	22
2639	LOWER SALFORD TWP AUTH	3.970E+01	0	73.29	3	22
2460	SCHWENKSVILLE BOROUGH AUTH	3.970E+01	0	73.29	3	22
2474	EXETER TOWNSHIP WWTR TRTMT PLT	7.664E+02	8	78.29	1	26
2492	GPU GENERATION INC TITUS GENERATING STATION	4.166E+02	36	78.29	1	27
821	AMBLER BORO	5.174E+02	22	62.95	2	28
1614	LIMERICK TWP MUN AUTH	2.191E+02	4	76.11	2	29
2509	WYOMISSING VALLEY JOINT MUN AU	1.043E+03	37	78.29	0	30
783	AMBLER BOROUGH WATER DEPT	3.970E+01	0	63.16	3	31
782	PENN HISTORICAL & MUSEUM COMM	3.970E+01	0	63.16	3	31
2756	HIGH POINT BAPTIST CHAPEL	3.970E+01	0	78.34	2	33
2445	POST OFFICE INN CORP	3.970E+01	0	78.34	2	33
464	CONSHOHOCKEN SEW TREAT. PLT.	4.091E+02	12	62.95	2	35
2518	ROBESONIA-WERNERSVILLE M/A OF	2.809E+02	20	80.00	1	36
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	4.166E+02	10	78.29	1	37
509	LUKENS STEEL CO	4.166E+02	0	62.95	2	38
2470	BIRDSBORO BORO MUN AUTH	2.455E+02	18	78.29	1	39
2547	NGK METALS CORP.	4.166E+02	47	78.29	0	40

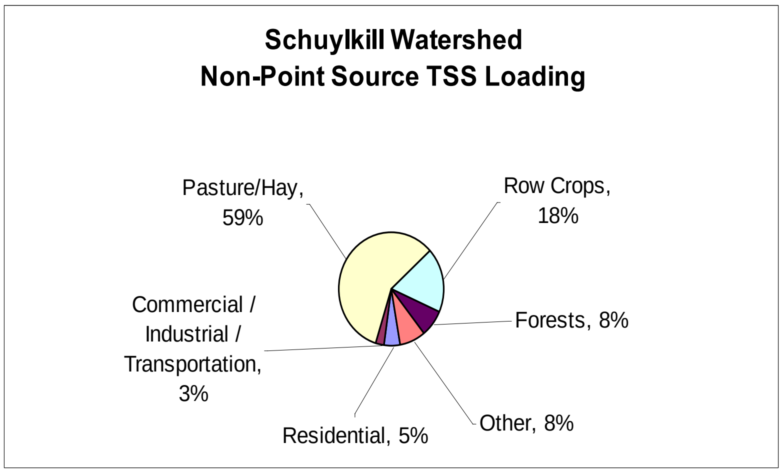
Table 3.1.3-10 Priority Non-Point Source Locations for Total Organic Carbon in the Schuylkill River Watershed

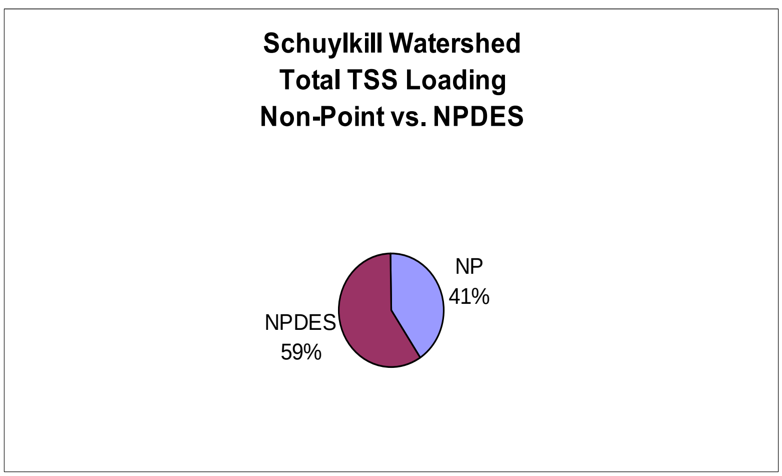
Source ID	Source Name	TOC (lbs./day)	Intake Weight (%)	Zone A	Score
90027	Trout Creek-027	2.941E+02	67.50	4	1
90024	Stony Creek-024	4.904E+02	65.23	3	2
90008	Wissahickon Creek-008	6.651E+02	62.95	2	3
90289	Schuylkill River-289	2.791E+02	78.33	3	4
90164	Schuylkill River-164	2.566E+02	76.11	3	5
90003	Schuylkill River-003	1.088E+03	26.05	0	6
90020	Schuylkill River-020	4.762E+02	62.95	2	7
90045	Towamencin Creek-045	2.042E+02	73.29	3	8
90135	French Creek-135	1.906E+02	73.29	3	9
90042	Skippack Creek-042	1.483E+02	73.29	3	10
90049	Perkiomen Creek-049	1.376E+02	73.29	3	11
90051	Lodal Creek-051	7.096E+01	73.29	3	12
90154	Schuylkill River-154	2.529E+02	74.51	2	13
90044	Zacharias Creek-044	6.837E+01	73.29	3	14
90052	Perkiomen Creek-052	6.653E+01	73.29	3	15
90039	Mine Run-039	5.413E+01	73.29	3	16
90193	Schuylkill River-193	3.993E+02	78.29	1	17
90046	West Branch Skippack Creek-046	4.848E+01	73.29	3	18
90007	Wissahickon Creek-007	3.005E+02	62.95	2	19
90009	Sandy Run-009	3.003E+02	62.95	2	20
90038	Perkiomen Creek-038	4.654E+01	73.29	3	21
90105	Schuylkill River-105	2.175E+02	73.29	2	22
90018	Plymouth Creek-018	2.715E+02	62.95	2	23
90035	Valley Creek-035	2.206E+02	67.50	2	24
90034	Little Valley Creek-034	2.092E+02	67.50	2	25
90291	Stony Creek-291	5.162E+01	78.31	2	26
90265	Mill Creek-265	2.217E+02	78.29	1	27
90106	Pickering Creek-106	7.197E+01	39.90	3	28
90326	Schuylkill River-326	2.181E+02	78.31	1	29
90236	Tulpehocken Creek-236	3.769E+02	80.00	0	30
90323	Mill Creek-323	1.854E+02	78.70	1	31
90047	Skippack Creek-047	2.119E+02	73.29	1	32
90238	Schuylkill River-238	3.679E+02	78.29	0	33
90267	Maiden Creek-267	1.735E+02	78.29	1	34
90248	Moselem Creek-248	1.710E+02	78.29	1	35
90271	Maiden Creek-271	1.456E+02	78.29	1	36
90252	Sacony Creek-252	1.370E+02	78.29	1	37
90315	Schuylkill River-315	3.105E+02	78.29	0	38
90057	East Branch Perkiomen Creek-057	1.450E+02	73.29	1	39
90069	Swamp Creek-069	1.436E+02	73.29	1	40

Total Suspended Solids (Turbidity)

Turbidity was analyzed using total suspended solids (TSS) as a surrogate. As seen in Figure 3.1.3-10, TSS is associated primarily with agricultural lands uses. Though the qualitative analysis suggests that NPDES discharges can be a controlling source of turbidity, water quality data suggest otherwise. In fact, data show that non-point source runoff tends to control turbidity, as evidenced by the increased values during the wetter seasons.

Figure 3.1.3-10 Land Use Load Percentages and Loading by Source Type associated with Total Suspended Solids





As shown in Figure 3.1.3-11 and Tables 3.1.3-11 and 3.1.3-12, high priority point sources for TSS are located primarily along the mainstem of the Schuylkill River between Reading and Philadelphia and within the Lower Perkiomen Creek subwatersheds. A cluster of wastewater treatment plants also scored high in the Wissahickon subwatershed. These sources include the Ambler Borough Municipal Authority and Abington Township Community Waste Water Treatment Plant as well as some such industrial point sources such as McNeil Consumer Products, Inc. and the Valley Green Corporate Center. The Montgomery County Sewer Authority scored highly, although its intake withdrawal weight is relatively low, due to the high levels reported for TSS and 218 discharge monitoring report violations on record between 1997 and 2003.

The high priority subsheds are located primarily in the Lower Perkiomen, Tulpehocken, and Maiden Creek subwatersheds. Since TSS is associated with agricultural land uses, it makes sense that these subsheds would score as the highest protection priority for TSS since the majority of the watershed’s agricultural activities occur in these areas. The exception to this is the Wissahickon Creek-008 subshed, an urbanized area, which scored very highly in this prioritization due to high loading results for TSS and three drinking water intakes within a five hour time of travel.

Non-point sources tend to show much higher loading with less frequency. The NPDES sites have lower rates of TSS loading; however, they are more constant discharges. Loading rates from runoff appear to be high enough to cause concern for cumulative impacts at the intakes during storm events.

Figure 3.1.3-11 Priority Source Locations (Total Suspended Solids)

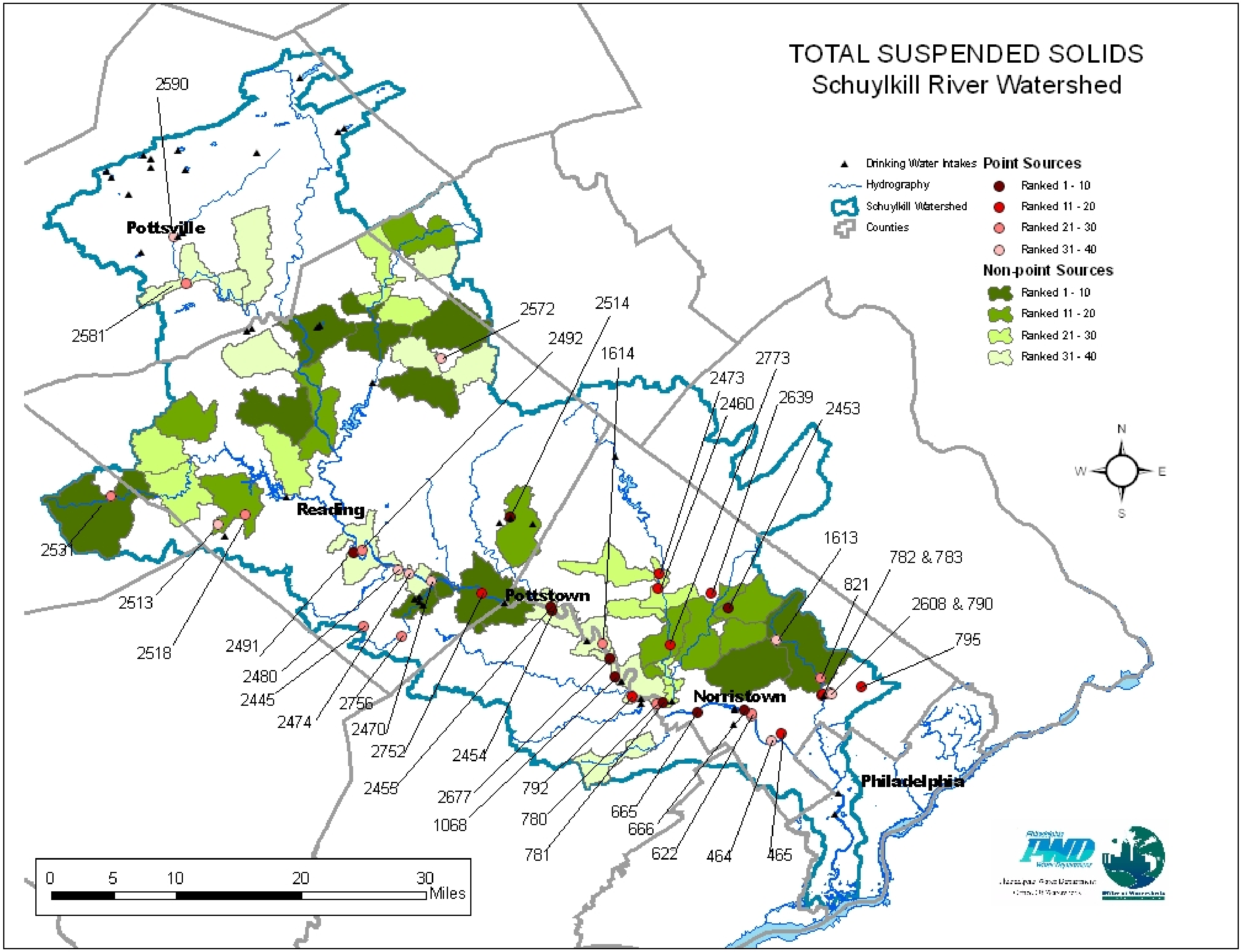


Table 3.1.3-11 Priority Point Source Locations for Total Suspended Solids in the Schuylkill River Watershed

Source ID	Source Name	TSS (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
666	NORRISTOWN MUN WASTE AUTH	8.024E+05	24	62.95	2	1
781	MONTGOMERY COUNTY SEW AUTH	1.440E+04	218	67.50	2	2
2455	POTTSTOWN BORO	2.279E+04	39	76.11	3	3
1068	PECO ENERGY CO-CROMBY GENERATING	2.420E+01	0	74.51	4	4
2677	SPRING CITY BOROUGH SEWAGE PLANT	2.420E+01	0	74.51	4	4
665	UPPER MERION MUN UTILITY AUTH	2.088E+03	13	67.50	4	6
2491	READING CITY	5.534E+04	92	78.29	1	7
2453	UPPER GWYNEDD-TOWAMENCIN MUN	1.394E+03	25	73.29	3	8
2514	BOYERTOWN BORO	2.420E+01	0	76.38	3	9
2454	NORTH COVENTRY MUN AUTH STP	8.040E+01	0	76.11	3	10
792	PHOENIXVILL BORO STP	2.383E+03	6	73.29	3	11
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	2.420E+01	0	73.29	3	12
2473	LOWER FREDERICK TOWNSHIP TRT P	2.420E+01	0	73.29	3	12
2639	LOWER SALFORD TWP AUTH	2.420E+01	0	73.29	3	12
2460	SCHWENKSVILLE BOROUGH AUTH	2.420E+01	0	73.29	3	12
465	WHITEMARSH TWP SEW AUTH	1.500E+03	72	62.95	2	16
2752	120 OLD PHILADELPHI	8.588E+03	4	78.29	2	17
783	AMBLER BOROUGH WATER DEPT	2.420E+01	0	63.16	3	18
782	PENN HISTORICAL & MUSEUM COMM	2.420E+01	0	63.16	3	18
795	ABINGTON TWP COMM-WWTR TRTMT P	5.474E+03	51	62.95	2	20
2756	HIGH POINT BAPTIST CHAPEL	2.420E+01	0	78.34	2	21
2445	POST OFFICE INN CORP	2.420E+01	0	78.34	2	21
1614	LIMERICK TWP MUN AUTH	4.720E+02	4	76.11	2	23
780	VALLEY FORGE SEWER AUTHORITY	1.001E+04	12	67.50	2	24
2531	MYERSTOWN STP	9.580E+02	31	80.00	1	25
2492	GPU GENERATION INC TITUS GENERATING STATION	9.800E+02	36	78.29	1	26
821	AMBLER BORO	1.100E+04	22	62.95	2	27
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	1.060E+04	19	62.95	2	28
2581	SCHUYLKILL HAVEN MUN AUTH-STP	4.401E+03	79	78.29	0	29
2518	ROBESONIA-WERNERSVILLE M/A OF	5.397E+02	20	80.00	1	30
464	CONSHOHOCKEN SEW TREAT. PLT.	8.273E+03	12	62.95	2	31
2470	BIRDSBORO BORO MUN AUTH	1.071E+03	18	78.29	1	32
1613	UPPER GWYNEDD TWP	6.778E+03	61	62.95	1	33
622	BRIDGEPORT BORO	2.420E+01	0	66.16	2	34
2572	KUTZTOWN MUN AUTH MUN SEW TREATMENT PLANT	5.990E+02	12	78.29	1	35
2474	EXETER TOWNSHIP WWTR TRTMT PLT	3.602E+03	8	78.29	1	36
2590	GREATER POTTSVILLE AREA SEW AUTH	1.455E+04	54	78.29	0	37
2480	CROMPTON & KNOWLES CORP	7.500E+01	10	78.29	1	38

Source ID	Source Name	TSS (lbs./day)	DMRs	Intake Weight (%)	Zone A	Score
	GIBRALTAR PLT					
2513	READING ALLOYS INC.	2.420E+01	1	80.00	1	39
790	MCNEIL CONSUMER PRODUCTS CO.	2.420E+01	0	63.16	2	40
2608	VALLEY GREEN CORPORATE CENTER	2.420E+01	0	63.16	2	40

Table 3.1.3-12 Priority Non-Point Source Locations for Total Suspended Solids in the Schuylkill River Watershed

Source ID	Source Name	TSS (lbs./day)	Intake Weight (%)	Zone A	Score
90236	Tulpehocken Creek-236	2.464E+04	80.00	0	1
90289	Schuylkill River-289	9.942E+03	78.33	3	2
90265	Mill Creek-265	1.543E+04	78.29	1	3
90190	Hay Creek-190	4.806E+02	78.50	5	4
90024	Stony Creek-024	8.298E+03	65.23	3	5
90008	Wissahickon Creek-008	1.177E+04	62.95	2	6
90164	Schuylkill River-164	5.348E+03	76.11	3	7
90283	Irish Creek-283	1.489E+04	78.29	0	8
90267	Maiden Creek-267	1.061E+04	78.29	1	9
90248	Moselem Creek-248	1.049E+04	78.29	1	10
90167	Ironstone Creek-167	3.012E+03	76.29	3	11
90048	Doe Run-048	3.175E+03	73.29	3	12
90282	Schuylkill River-282	1.275E+04	78.29	0	13
90042	Skippack Creek-042	3.052E+03	73.29	3	14
90049	Perkiomen Creek-049	2.737E+03	73.29	3	15
90277	Ontelaunee Creek-277	1.239E+04	78.29	0	16
90044	Zacharias Creek-044	2.387E+03	73.29	3	17
90224	Little Northkill Creek-224	1.161E+04	80.00	0	18
90213	Spring Creek-213	1.153E+04	80.00	0	19
90045	Towamencin Creek-045	2.047E+03	73.29	3	20
90038	Perkiomen Creek-038	2.032E+03	73.29	3	21
90051	Lodal Creek-051	1.990E+03	73.29	3	22
90040	Perkiomen Creek-040	1.614E+03	73.29	3	23
90234	Tulpehocken Creek-234	1.099E+04	80.00	0	24
90065	Swamp Creek-065	1.522E+03	73.29	3	25
90233	Mill Creek-233	1.087E+04	80.00	0	26
90052	Perkiomen Creek-052	1.415E+03	73.29	3	27
90271	Maiden Creek-271	7.388E+03	78.29	1	28
90269	Maiden Creek-269	7.342E+03	78.29	1	29
90209	Plum Creek-209	1.040E+04	78.29	0	30
90035	Valley Creek-035	4.837E+03	67.50	2	31
90154	Schuylkill River-154	3.708E+03	74.51	2	32
90287	Mill Creek-287	9.678E+03	78.29	0	33
90252	Sacony Creek-252	6.132E+03	78.29	1	34
90193	Schuylkill River-193	5.936E+03	78.29	1	35

Source ID	Source Name	TSS (lbs./day)	Intake Weight (%)	Zone A	Score
90256	Sacony Creek-256	9.286E+03	78.29	0	36
90105	Schuylkill River-105	2.727E+03	73.29	2	37
90275	Kistler Creek-275	8.886E+03	78.29	0	38
90295	Schuylkill River-295	8.845E+03	78.29	0	39
90294	Pine Creek-294	8.704E+03	78.29	0	40

3.2. Philadelphia Water Department Initiatives - Detailed Project Descriptions

3.2.1 Background on Project Selection

Due to the large size of the Schuylkill River watershed, stakeholders often find it difficult to successfully cut across regulatory, municipal, and jurisdictional boundaries to implement their projects and programs. However, the successful implementation of these projects is critical to the protection and integrity of the water supply. In recognition of this problem, EPA, PADEP, and PWD formed the Schuylkill Action Network in spring 2003. Members of the SAN, including government agencies, local watershed organization, and water suppliers, work in partnership to obtain funding, implement projects, and protect the water resources of the Schuylkill River watershed rather than competing with one another and duplicating efforts.

The prioritizations of potential sources outlined in the previous section help members of the SAN to target specific areas of the watershed in greatest need of restoration and protection efforts. PWD and the SAN have developed a list of projects outlined in Table 3.4, based upon the results of the SWPP prioritization, PADEP's 303(d) stream assessment, and the project's location along a stream with a designated TMDL. The SAN member organization responsible for implementing the project or program is based upon several factors including the type of project, the size and cost of the project, and the organization's ability to spend funding on a project outside of jurisdictional boundaries. The organization's overall mission is also a factor when determining who will implement and fund the various projects.

For example, while PWD is one of the founding members of the SAN and participates heavily in the various workgroup activities and in providing technical guidance, PWD does have a responsibility to protect the water quality for its 1.1 million customers supplied with water from the Schuylkill River watershed; specifically the water quality of the Wissahickon and Lower Schuylkill subwatersheds as they are the direct source of withdrawal for the PWD-Belmont and Queen Lane intakes. In response to this charge, PWD is planning to implement over 20 projects and initiatives during the next five years, which are expected to show cumulative improvements in water quality in the Wissahickon and Lower Schuylkill subwatersheds. These projects are all located within the Zone B delineation area for the Belmont and Queen Lane intakes identified in Figures 2.2.2-3 and 2.2.2-4 of the "Zone Delineation" section. Similarly, other water suppliers within the SAN will focus their protection efforts within their service areas, while providing support and partnership in other regions of the watershed.

Other SAN members who need to work within their jurisdictional boundaries include the Berks County Conservation District and Berks County Conservancy, who will focus their efforts in the Tulpehocken and Maiden Creek subwatersheds. The Pennsylvania Environmental Council will work in priority areas throughout the Schuylkill River watershed, while the Schuylkill Headwaters Association will primarily address abandoned mine drainage in the Upper Schuylkill subwatershed. While the jurisdictional boundaries of each of these organizations may sometimes make implementation of various projects and programs cumbersome, it only reinforces the need for an organization like the SAN. In a watershed of this size, a partnership of organizations is necessary so that stakeholders can build off the expertise and work already completed by other organizations to see cumulative improvements in water quality.

In June 2004 the SAN was awarded $1,149,340 through EPA's Targeted Watersheds Initiative Program for the implementation and construction of "demonstration projects" throughout the Schuylkill River watershed. The grant will be managed by the Partnership for the Delaware Estuary (PDE) and is expected to act as "seed money" for the SAN to launch the group's various initiatives. PDE was selected to oversee the grant due to their previous experience and success in managing large grant awards and their ability to implement projects throughout the watershed. PDE has received additional funding from the William Penn Foundation to develop a business plan for a long term sustainable funding source dedicated to the restoration and protection of the Schuylkill River watershed.

The majority of funding for potential PWD projects and initiatives will remain separate from the SAN and Watersheds Initiative grant. The funding for these projects will be provided by the City of Philadelphia or through other grants and funding programs outlined Section 4.1 of this protection plan. The following are detailed descriptions of the projects and initiatives currently planned or already underway through the direction of PWD. These project descriptions relate to Table 3.4, which is located after the "Schuylkill Action Network Projects - Detailed Project Descriptions".

3.2.2 Project Descriptions

Bacteria Source Tracking Study

In order to address the high bacteria loadings in the Wissahickon Creek subwatershed, the source of bacteria contamination must first be identified. The Bacteriological Source Tracking (BST) project will attempt to identify the sources of bacterial contamination of the Wissahickon through the collection of fecal material from a variety of potential contamination sources such as humans, livestock, geese populations, etc. A comprehensive bacteria library will be established for the purpose of comparing bacteria data collected from water samples to the specimens collected from the potential sources. By connecting the source of contamination to the contaminant itself we will be able to identify priorities for effectively reducing pathogen loadings in the Wissahickon Creek.

Bells Mill Run at Cathedral Road Plunge Pool

The headwaters of Bells Mill Run, a tributary of Wissahickon Creek, originate at a PWD stormwater outfall. The outfall has significant pooling that result in standing water and water quality degradation during low flows. The streambeds downstream of the outfall have suffered erosion resulting from high storm flows. This project will address both the pooling and the erosion through redesign of the plunge pool area and some portion of the tributary downstream.

Belmont Intake Phase II Meadow Extension

In 1999 Phase I of the Belmont intake project was initiated with the establishment of a meadow a length of 1000 ft along the bank of the Schuylkill River just upstream from our Belmont drinking water intake. The high population of resident Canadian geese in this area resulted in a total loss of ground cover, increased runoff, and high nutrient and bacteria concentrations discharging directly at or above our drinking water intake. The height of the meadow alone created a fear of predation which successfully deterred the goose population from this area, while also providing a treatment feature for stormwater runoff. In July of 2004 this meadow was extended 1200 ft upstream of the intake to further deter geese from the intake area and reduce nutrient and pathogen loadings in the Schuylkill River. Phase II of the project continues with the establishment of substantial fencing around the perimeter of Peter's Island, a small island in the middle of the Schuylkill River which acts as a nesting ground for the local geese, supporting the high resident populations. This additional fencing, along with the revegetation of the island with 50 lbs of river rye and oat seed, should further reduce geese activity in the entire area and limit nutrient and bacteria loadings on the Schuylkill River.

Carpenter's Woods

The headwaters of this un-named tributary to the Wissahickon Creek originate from two PWD stormwater outfalls. The channels from the outfall locations to the mainstem of the creek are severely eroded. This project has two potential restoration scenarios. The first would be to perform fluvial geomorphological design for the two stream channels from the outfalls to the existing stream bed. The second option would be to create a stormwater wetland in the park parcel to the north of the outfalls that would capture, detain, treat and release the stormwater from those two outfalls before discharging into the Carpenter's Woods tributary to the Wissahickon Creek.

Courtesy Stables Runoff Treatment Project

The Courtesy Stables Runoff Treatment Project is aimed at correcting a suite of problems contributing to nutrient-laden stormwater that flows from the barnyard through an adjacent wetland and into a tributary of the Wissahickon Creek. The intent of this project is to route stormwater from the barnyard and surrounding area into a grassed waterway/filter strip where nutrients and sediment will be removed and a portion of the water will infiltrate before reaching the wetland. Flow from a springhouse will be routed directly to the wetland, serving as a continuous source of clean water, rather than through the riding ring, where it adsorbs nutrients and creates muddy conditions. Invasive plant species onsite will be removed and replaced with Philadelphia-native trees and shrubs and educational signage will be erected, linking the nutrient runoff reduction to the improvement of the Schuylkill River watershed.

Early Warning System Reporting Initiative

Dischargers permitted by PADEP are currently required to notify downstream treatment plant operators and emergency response personnel in the case of a an accidental overflow, contaminant spill, or any other event that would negatively impact the quality of water leaving the site beyond what is allowed by the permit. PADEP representatives then notify the EWS when such an event occurs. The purpose of the Early Warning System (EWS) Reporting Initiative is to expand the existing network of EWS users, provide training sessions on how to use the EWS, and ultimately have dischargers enter events directly into the EWS. Because the EWS generates immediate phone call and email notifications to downstream water suppliers and emergency response personnel complete with incident details and time of travel models, this would increase the speed, reach, and accuracy of downstream notifications and would ensure the ability of downstream water suppliers to properly modify treatment operations to accommodate unusual water quality events.

Environmental Advisory Committee Initiative

Environmental Advisory Committees (EACs) are volunteer groups recruited and convened by townships to participate in and advocate sound environmental practices and initiatives in their community. They are dedicated environmental advocates that support local governments and communities. The Source Water Assessments conducted in the Schuylkill watershed determined that townships with EACs generally had more environmentally sound approaches to land management and development. Therefore, assessment recommendations included establishing EACs in high priority areas. Pennsylvania Environmental Council (PEC), one of PWD's partners, has an established outreach program designed to work with township officials in developing EACs. PEC is interested in expanding its existing program by reaching out to more communities throughout the Schuylkill watershed. Through a grant provided by Water Resources Education Network, PWD will identify five to ten priority townships based on the source water assessments and work with PEC to establish EACs in those targeted communities.

Erdenheim Farms

This project involves working with partners to acquire an easement of a 500 acre greenspace area primed for development located directly along Wissahickon Creek. This project will also include developing proper ordinances and best management practices for site development and runoff controls to reduce stream flooding and impacts, as well as riparian buffer preservation for water supply protection and restoration trails.

Erosion and Sedimentation Inspector

Improper erosion and sedimentation (E&S) measures can result in the discharge of excessive quantities of runoff and sediment into the watershed, increasing streambank erosion and downstream contamination. Construction sites are often required to obtain an NPDES permit for this discharge and are required to take adequate measures to reduce and limit sediment discharge. To ensure compliance with the NPDES permit, ensure the maximum efficiency of E&S controls in residential, commercial, and development sites, PWD will hire an official E&S Inspector. The hiring of an E&S Inspector will help to decrease the unnecessary discharge of high volumes of sediment-laden water into the City's streams and ensure the measures utilized for erosion and sedimentation control are performing according to their full potential.

General Cryptosporidium Infectivity/Viability Study

PWD has been working to identify potential sources and develop plans for mitigation of *Cryptosporidium* in its watershed since 1993. Until recently, analytical techniques to identify the type of source and its viability were not available, nor could the method accurately and precisely recover *Cryptosporidium* from water or other matrices to aid in watershed management planning. Recent advancements now provide an acceptable and accurate analytical method that can isolate *Cryptosporidium* from wastewater effluent matrices and measure viability. Using this information the impact and significance of wastewater discharges using ultraviolet light disinfection can be assessed. PWD can ultimately develop strategies to support upstream sewage treatment plant upgrades to ultraviolet light disinfection if it provides substantial reduction in *Cryptosporidium* oocyst viability and infectivity.

Gorgas Lane Plunge Pool

The Gorgas Lane Plunge Pool project is similar in cost and scope to the Bells Mill Run at Cathedral Road Plunge Pool project. The Gorgas Lane project addresses pooling and erosion through redesign of the plunge pool area that has significant pooling, which results in standing water and water quality degradation during low flows. The Gorgas Lane Plunge Pool also originates at a PWD stormwater outfall located within the Wissahickon Creek subwatershed.

Livezy Dam Removal

Livezy Dam has been recommended for removal or breaching by Fairmount Park's Natural Lands Restoration and Environmental Education Program's Master-Plan for the Wissahickon Creek subwatershed. It is also anticipated that Livezy Dam will be recommended for removal during other planning initiatives (PA-Fish & Boat Analysis and PA-DEP/EPA TMDL process for the Wissahickon Creek). Removal of Livezy Dam will help restore natural flow patterns in this area of the Creek, and will decrease the detrimental water quality impacts that "ponding" has on a stream. Those impacts include water temperature increases, higher algal growth and lower D.O. levels.

Manayunk Canal Aeration Project

PWD is piloting the use of surface aeration in the Manayunk canal in the Lower Schuylkill subwatershed to enrich the canal water with oxygen and provide a measure of safety against fish kills. During summer, algae and decomposing organic matter frequently accumulate in the canal. Along with warmer water temperatures and periodic inputs of untreated stormwater, algae blooms may result in severe oxygen stress for the canal's fish and other aquatic life. Floating surface aeration devices have been purchased and are ready to be deployed on a temporary basis. Aeration devices will soon be installed on a permanent basis throughout the summer and early fall.

Monestary Stables Stormwater Diversion & Detention Project

Lack of proper stormwater management controls, a sloping topography toward the bordering Wissahickon Creek, and the intensity of horse activity on the site make Monastery Stables a potentially significant source of contamination to Wissahickon subwatershed. Presently, rainfall collects in the paddocks and discharges toward the Wissahickon through several eroded gullies, carrying sediment, nutrients, and harmful pathogens. This project will introduce stormwater management controls to increase stormwater infiltration, and direct and treat stormwater runoff, reducing sediment, nutrient, and harmful pathogen loadings on the Wissahickon Creek.

On-Line Monitoring at Water Treatment Plant Intakes

The Delaware Valley Early Warning System (EWS) is a comprehensive water quality monitoring, communication, and notification system linking water suppliers and emergency response personnel throughout the Schuylkill River and Delaware River watersheds. Through the interactive website and telephony systems, the EWS allows users to enter emergency water quality events, review current and historic events, and browse water quality data to observe historic trends. When water quality events are entered into the system, a detailed notification is immediately sent to all downstream users, instantly generating time of travel models to allow treatment plant operators to modify plant operations accordingly. In addition to receiving physical and chemical data from USGS gage stations throughout the Schuylkill River and Delaware River watersheds, the EWS Online Monitoring Network currently receives real-time 15 minute water quality data from five drinking water treatment plants within the two watersheds. This network will be expanded to include real time and historical data from numerous other locations throughout the two watersheds and pilot advanced technology for the detection and real-time monitoring of toxic substances. The expansion of this network will greatly improve the speed and accuracy of emergency response and heighten the level of watershed understanding throughout the water supply and emergency response communities.

Philly RiverCast

The Philly RiverCast is a forecast of water quality that predicts potential levels of pathogens in the Schuylkill River between Flat Rock Dam and Fairmount Dam. Using technology already created in support of the Delaware Valley Early Warning System, the Philly RiverCast inputs real-time turbidity, flow, and rainfall data from the water department's Queen Lane treatment plant and flow data from the United States Geological Survey into a model that predicts bacteria levels under current conditions. The forecast system associates the model output with a "safety rating" that clearly indicates current conditions to the general public. The "safety rating" is determined using a formula created by PWD and other stakeholders, including the City of Philadelphia Department of Public Health. This "safety rating" will be made available on the Philly RiverCast website (www.phillyrivercast.org), from the Fairmont Water Works Interpretive Center, and the SAN website and advertised using a series of public service announcements via radio and other media channels.

Saylor Grove Stormwater Wetland

A 1-acre stormwater wetland was constructed in the spring of 2005, on a parcel of Fairmount Park known as Saylor Grove. The 1-acre wetland is designed to treat an estimated 70 million gallons of urban stormwater per year before it is discharged into the Monoshone Creek, a tributary of the Wissahickon Creek. This site is located within the direct drainage area for both PWD's Belmont and Queen Lane intakes. The function of the wetland is to treat stormwater runoff in an effort to improve source water quality and to minimize the impacts of storm-related flows on the aquatic and structural integrity of the riparian ecosystem. This project is a highly visible urban stormwater BMP retrofit in the Wissahickon subwatershed.

Stormwater Regulations Development

PWD has revised the City of Philadelphia's stormwater regulations. The new guidelines include new approaches to stormwater management which include controls to improve the quality of stormwater prior to discharge, controls to reduce the erosive effects of stormwater, and measures to increase groundwater recharge. The new stormwater regulations in Philadelphia will ensure that Philadelphia has an up-to-date and effective stormwater program that meets the state and federal requirements and can be coordinated with the changing regulations occurring in upstream municipalities.

Technical Assistance for Schools

Federal monies will fund technical assistance from a consultant to establish a conceptual design for effective stormwater management controls and retrofits at two schools in the Wissahickon subwatershed.

W.B. Saul High School Project

The W.B. Saul High School project will combine urban stormwater and agricultural BMPs to reduce the harmful impact of the school's runoff on the water quality of the Wissahickon Creek. Cattle crossings, cattle fencing, and riparian buffers will be used to limit the impact of livestock on the runoff quality and prevent harmful pathogens and nutrients from entering the watershed. Prior to discharging into the sewer, which then flows to the Wissahickon, agricultural runoff from the livestock and farming practices, as well as stormwater runoff from the school's roofs and parking lots, will be captured and treated though a series of long pools connected by wetland swales. This project will add a significant educational component to the curriculum of Saul High School, already one of the nation's premier agricultural high schools, by demonstrating proper management of agricultural runoff.

Watershed Information Center

In early 2005, PWD developed a conceptual plan for a web-based "Watershed Information Center." The Center is a regional resource of Southeastern Pennsylvania watershed-related information that centrally locates technical, management, and administrative tools and capabilities to support those involved in watershed planning. The Watershed Information Center is located at www.PhillyRiverInfo.org and www.SoutheastPaRiverInfo.org. Information on the site is organized by watershed and by the PWD program which generated the information. Additional content is being developed and added to site, and PWD will also refine the homepage to include more interactive capabilities, a search function, and discussion boards.

Waterways Restoration Team

Creation of several, regional groups responsible for cleaning and maintaining approximately 100 stream miles within the City of Philadelphia's watersheds. The teams will remove large objects, debris, and sediment around outfalls, bridge abutments, and dams to ensure the free flow of streams.

Wissahickon Feasibility Study

The Wissahickon Feasibility Study is a combined effort by the PWD and Army Corps of Engineers to evaluate all reasonable options for improving water quality and creating fish passage in the Wissahickon subwatershed. The current study area for the Feasibility Study includes the portion of the Wissahickon subwatershed falling within city boundaries. The Feasibility Study will last approximately 3-4 years and lead to a Design Phase, during which the Army Corps will lay out detailed designs for the most viable options determined during the Feasibility phase. The Design Phase will lead to a Construction Phase, during which the projects detailed during the design phase will be implemented. Options for the Bells Mill Run and Gorgas Lane Plunge Pool projects previously mentioned in this section will also be included in this study.

Sewer Related Project Descriptions

Dobson's Run Elimination

Due to flooding problems, temporary dams were installed in the Dobson's run storm sewer. Flow was diverted to the Wissahickon High Level interceptor at Stokley Street and Roberts

Avenue. PWD has begun a $6,500,000 program of sewer construction that will allow one of the dams to be removed from service. Two additional phases of the project are planned, which will eventually eliminate the remaining dam from service.

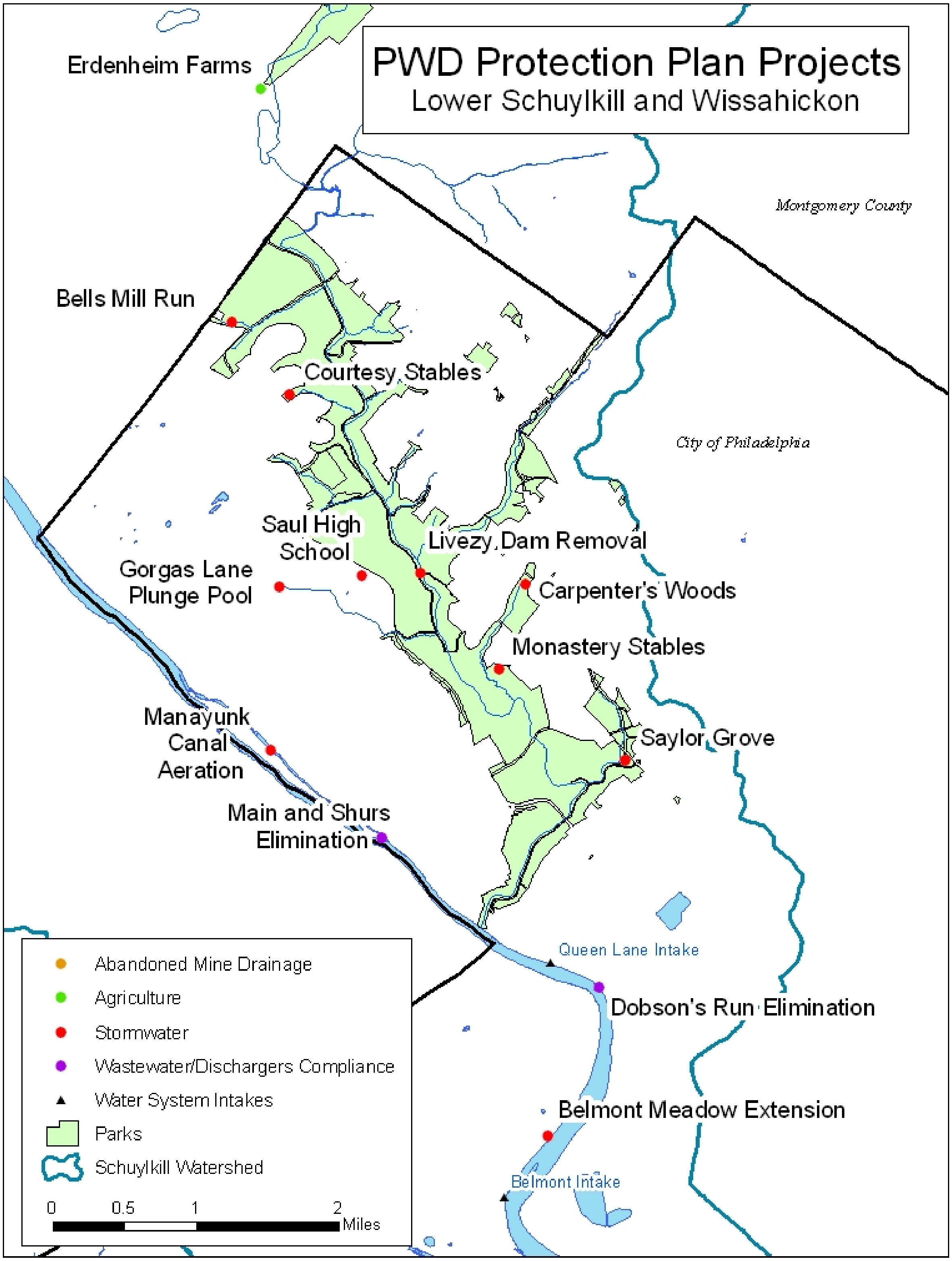
Main and Shurs Elimination

The Upper Schuylkill East Side Intercepting sewer conveys sanitary sewage from the Manayunk/Roxborough section of the City of Philadelphia to the City's Southwest Water Pollution Control Plant, where it is treated and released to the tidal portion of the Schuylkill River. During some wet weather events, excessive infiltration and inflows to the sewer result in flows that exceed the existing capacity of the interceptor. Currently, there is an overflow in the interceptor located at Main Street and Shurs Lane. This overflow provides relief during these wet weather events. When the capacity of the interceptor is exceeded, some flow is diverted to the tidal Schuylkill River through the existing overflow. In order to eliminate the overflow without adversely impacting the system when compared to current conditions, the relief provided by the overflow must be equaled/exceeded or the amount of infiltration and inflow must be reduced to a level that will not exceed the capacity of the existing interceptor. The most feasible and cost effective solution identified to date for eliminating the overflow is to construct approximately 3 million gallons of off-line storage as close to the existing overflow as possible. The most suitable location currently under investigation is the lower end of Venice Island. Construction of the overflow will not only allow for the elimination of the overflow but also reduce the occurrence of basement and street level flooding directly associated with the interceptor during large rainfall events.

Wissahickon/Monoshone Defective Laterals Program

Under the Lateral Guarantee Program, PWD provides for the detection and abatement of residential cross connections, preventing harmful pathogens from entering the City's streams from improper residential sanitary sewer connections. As part of this program, PWD conducts routine inspection of its 434 storm water outfalls to determine the existence of cross connections contributing sanitary waste to the watershed in dry flow conditions. When fecal coliform is detected in dry flow conditions, dye testing is conducted to identify the exact locations of the cross connections. An annual funding allotment of $2.5 million is available in the form of City-funded cross connection abatements and HELP loans for the remediation of defective laterals. PWD will continue to concentrate efforts in the Wissahickon and Monoshone subwatersheds, where many of the City's defective laterals are located.

Figure 3.2.1-1 PWD Project Locations in the Wissahickon and Lower Schuylkill Subwatersheds



3.3 Schuylkill Action Network Projects - Detailed Project Descriptions

The following project descriptions relate to the projects identified in Table 3.4 as a priority for implementation or construction that will be realized through the designated SAN workgroup.

3.3.1 Abandoned Mine Drainage Projects

Pine Forest

Abandoned mine drainage (AMD) from the Pine Forest Mine pump shaft contributes aluminum, iron, manganese, and acidity to Mill Creek, a tributary to the Schuylkill River in Schuylkill County, resulting in Mill Creek's 303(d) list "impaired because of metals" designation. The goals of this project are the elimination of metals and the neutralization of acidity in the Pine Forest Mine discharge through the installation of a passive treatment system consisting of a flushable, anoxic limestone drain (ALD) and aerobic wetland basin. This project will not only address the metal and pH issues of the Pine Forest discharge, but will demonstrate the effectiveness of using an anoxic limestone treatment for large volume discharges with near-neutral pH, low dissolved oxygen, and moderate metals concentrations.

Pine Knot

The Pine Knot Drainage Area drains over 20 square miles of mine tunnels, or approximately 35 million gallons per day. Over 50% of metals in the Upper Schuylkill come from the Pine Knot drainage area. This project will divert surface streams to reduce infiltration, implement active and passive technologies to eliminate metals and neutralize acidity, and explore innovative ways to block leakages from mine tunnels leading to the stream.

Reevesdale South Dip Tunnel

The discharge of abandoned mine drainage from the Reevesdale South Dip Tunnel has contributed significant aluminum, iron, manganese, and acidity to Wabash Creek, a tributary to the Little Schuylkill River in Schuylkill County, resulting in Wabash Creek's 303(d) list "impaired because of metals" designation. The goals of this project are the neutralization of acidity and the removal of metal loadings from the discharge through the implementation of a passive treatment system consisting of a flushable, oxic limestone drain (OLD) followed by an aerobic wetland basin. This project will not only address the metal and pH issues of the Reevesdale site but will demonstrate the effectiveness of using oxic limestone treatment for large volume, low pH, and iron-contaminated discharge.

Oakhill Boreholes

The Oak Hill Boreholes Site has been identified in a recent assessment of AMD sites in the Upper Schuylkill subwatershed as the top priority for remediation along the west branch of the Schuylkill River (L. Robert Kimball & Associates, 2000). With an average flow of 5.56 MGD, the Oak Hill Boreholes Site has been identified as the largest discharge and among the highest contributors of metals to the west branch of the Schuylkill River. The settling pond and weir system implemented as Phase 1 of this project will reach its full capacity within the next three years and be rendered useless in treating AMD. A feasibility study will be developed to address the limitations of the present system and determine the best means of further remediating the AMD issue at the Oak Hill Boreholes. The results of this feasibility study will then be implemented to continue treating AMD at the Oak Hill Boreholes site.

Silverbrook Mine

The Silverbrook Mine discharges an average of 2.14 MGD to the Little Schuylkill subwatershed from the gravity flow of deep mining operations, which have become inundated since abandonment. The discharge of AMD from the Silverbrook Mine has contributed significant amounts of aluminum, iron, manganese, and acidity to the Little Schuylkill subwatershed. A feasibility study will be developed to identify the best method for remediating the AMD issue at the Silverbrook Mine site.

3.3.2 Stormwater

Brookside Country Club

Built in the early 20th Century, this municipally owned golf course receives stormwater from surrounding neighborhoods. The country club has almost 2,000 ft of Sprogels Run on its property, as well as several unnamed first order tributaries that need riparian buffer restoration and stormwater protection. This project includes dam removal and streambank restoration at this site to address bank erosion, water conservation, and habitat enhancement.

Lansdale Borough

This project will restore a riparian buffer and retrofit several stormwater outfalls for infiltration along the headwaters of the Wissahickon Creek. The Wissahickon Creek is listed as impaired (303d-listing) due to stormwater impacts, and makes up a large portion of the source water for the Queen Lane Plant. The project will restore approximately 2,000 feet of eroded streambank with a native riparian buffer and retrofit several locations where residential stormwater is currently discharged to an impaired water body without any stormwater management. This project is located on borough parkland and has the potential to be expanded upstream to a school property. Thus the project will be quite visible and will offer the opportunity for education signage and even an outdoor learning environment.

Norristown Farm Park

This project will examine level of effort, costs, and other parameters associated with invasive species removal and riparian buffer installation on parkland adjacent to Stony Creek. Data collected and lessons learned during this project will help contribute to an overall strategy by the SAN in implementing BMPs on public land on a watershed-wide scale. Monitoring performed as a result of this study will provide baseline water quality data for Stony Creek. This information can be used as a baseline against which to compare results related to this project, thereby helping determine project success, as well as potential future projects selected by the SAN.

Norristown High School

The Norristown Area School District has its high school and Whitehall Elementary School campuses located along a 1.0 mile stretch of Stony Creek. The runoff generated from large parking lot areas is piped directly to Stony Creek, with no stormwater management. Stony Creek is listed as impaired (303d-listing) due to stormwater impacts. The creek flows through the campus and then towards the Borough of Norristown through the preserved farm park area, where the stream starts to recover thanks to sufficient riparian buffers and the absence of stormwater inputs. Stony Creek is a high priority for source water protection for Pennsylvania

American's Norristown Water Treatment Plant, located on the Schuylkill River directly downstream of the Stony Creek's confluence with the Schuylkill River. The project site is currently mowed to the edge, has eroding streambanks and does not have any type of stormwater management. The project entails restoring a native riparian buffer along the creek and constructing small bio-infiltration areas for stormwater discharged from several outfalls that drain approximately 10 acres of parking lots on the school campus.

Sandy Run Act 167 Plan

This project involves the development of a stormwater management plan (Act 167 Plan) for the Sandy Run subwatershed, which is located in the Lower Schuylkill majorshed. This effort will be led by the Montgomery County Planning Commission, who will work jointly with the municipalities within the Sandy Run subwatershed to address the effects of stormwater runoff resulting from development in this area.

Spring-Ford High School

This project includes the naturalization of a stormwater detention basin at Spring-Ford High School. The naturalization will help treat stormwater runoff draining to the basin from a large parking lot and several playing fields on the school's campus.

Watershed Wide Act 167 Plan Study

The SAN Watershed Land Protection Collaborative subcommittee will review the existing Act 167 Plans throughout the Schuylkill Basin to determine the level of protection provided by these plans to the watershed. The subcommittee will develop a system to rate the plans and identify specific strengths and weaknesses of each of the plans.

Wissahickon Detention Basin Study

The SAN Stormwater Workgroup received funding to conduct a study to investigate the feasibility of detention basin retrofits in the Wissahickon subwatershed. The study will result in an inventory of detention basins, conceptual designs for retrofitting several of those basins, and several demonstration projects. The inventory phase of this project is about 50% complete. Most of the newer basins are located in residential areas, while the older, larger basins are located in industrial parks. These larger basins will be targeted for the demonstration projects.

3.3.3 Wastewater Dischargers/Compliance

Act 537 Planning Workshop

The SAN Compliance Workgroup will consult with Pennsylvania's Act 537 planning program to understand issues surrounding failing septic systems and where to target the promotion of federal voluntary management programs for on-site and decentralized wastewater treatment systems (septic situations) to implement an educational program throughout the watershed. The workgroup will also host a series of workshops on the sewage management program, which will discuss the benefits of implementing a sewage management program, funding and financing of sewage systems, and lessons learned from local officials actively implementing management programs.

Case Study for Nutrient Trading

PADEP has developed a nutrient trading program that will examine the effectiveness of a market-based approach in addressing the challenges to reducing nutrient loads to Pennsylvania's waterways. In light of this program, PWD, in partnership with the SAN, will conduct a study specific to the Schuylkill watershed to identify opportunities for trading. The Wissahickon Creek is the first watershed in the Schuylkill basin to have a completed TMDL. Given that this TMDL directly impacts PWD and that the Wissahickon makes up a significant percentage of PWD's source water, a case study on nutrient trading in the Wissahickon will be a logical place for PWD to focus its efforts. Lessons learned through a Wissahickon case study will be transferred throughout the Schuylkill watershed and Pennsylvania.

Cryptosporidium Monitoring Requirement

EPA and PADEP members of the SAN Compliance Workgroup will investigate the inclusion of a *Cryptosporidium* monitoring requirement as part of the NPDES permit requirements. The workgroup will collect water quality data on *Cryptosporidium* at the drinking water intakes and develop a database for this information. The workgroup will then monitor *Cryptosporidium* discharges to establish permissible discharge levels and evaluate proper control techniques to transfer this information to WWTPs for implementation.

Point Source Ground-Truthing

The SAN Compliance Workgroup will use the listing of priority point source locations in the watershed identified in Section 3.1.3 of this protection plan. Members of the workgroup will visit these locations to determine the accuracy of the prioritization results and begin working with facility representatives on correcting any issues observed during these site visits.

Regional Wastewater Treatment Plant in Upper Schuylkill

Schuylkill Valley Sewer Authority and PADEP will lead this project through support from the SAN Compliance Workgroup to construct a 550,000 gallon per day treatment plant and more than 26 miles of new sanitary sewers in four municipalities where wildcat sewers are discharging untreated waste into the Schuylkill River, Morgan Run, Kaska Run, and abandoned mine shafts in the local area. The Schuylkill Valley Sewer Authority has already received a $17,623,500 loan and a grant of $1,118,000 for construction of the regional wastewater treatment plant.

Sewage Facility Self-Assessment Program

EPA will lead this project through the SAN Compliance Workgroup to identify municipal dischargers for a voluntary capacity management self assessment project. Dischargers will be provided with a self assessment form to answer questions about their facility regarding sewer collection capacity, maintenance, operation, and management. The assessments will take place on a subwatershed basis and the Compliance Workgroup will use the results to obtain a better understanding of how sewage facility operations impact the water quality of the Schuylkill River.

3.3.4 Agriculture

Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, and Cattle Crossing Installation

The SAN Agriculture Workgroup is creating a prioritization of farms for streambank fencing, cattle crossing, and riparian buffer projects. The workgroup will target farms for restoration projects based upon their location along an impaired stream reach and upon the parameters of most importance to the workgroup. Potential parameters include size of farmland parcel, soil erodibility, slope, stream order, the existence of easements, whether the parcel is a headwater parcel, and the location along contiguous farmland parcels. The group will use the results of the prioritization to identify candidate farms then do outreach to those farmers and implement buffers and fencing on 10 – 15 priority farms. Fencing and buffers will keep livestock out of the stream and slow down, reduce, and filter storm water run-off. This will reduce bacteria, nutrient and sediment loads to the stream.

3.3.5 Education/Outreach

Clean Water Partners

As major landowners, businesses are an important target for stormwater protection education. The Clean Water Partners project intends to reach out to this community by expanding an existing Partnership for the Delaware Estuary program that trains business owners and managers in ways to prevent stormwater runoff pollution on their properties. This program utilizes savings as an incentive for participation, emphasizing that prevention of stormwater runoff pollution is not complicated and does not have to be costly, while cleaning up water pollution after it has occurred can be both difficult and expensive. Volunteers are trained to evaluate sites and make suggestions for improving housekeeping practices; they sign a pledge indicating an agreement to incorporate best management practices on their properties, and they are encouraged to display a decal and certificate of participation in visible locations that indicate to customers and employees their concern about the environment.

Farm Awards and Certification Program

The Pennsylvania Environmental Agricultural Conservation Certification of Excellence (PEACCE) program educates livestock producers about potential sources of water pollution; identifies areas on their farms that are having or could have these negative impacts, and recommends sensible solutions to these challenges, including fencing, riparian buffers, manure management programs, and sound fertilizer and pesticide use for crops. This project involves providing incentives for farmers in the Schuylkill watershed that are participating in the PEACCE program to institute recommendations on their land. Lessons learned by farmers during project implementation will strengthen the impact of concepts taught during the program, and will be utilized to help educate future program participants.

Golf Course Certification Program

The SAN holds an annual workshop is held to introduce golf course managers within the Schuylkill River watershed to the Audubon Cooperative Sanctuary Program (ACSP) for golf courses. This voluntary education and certification program of Audubon International provides education, conservation assistance, and positive recognition to golf course managers for improving environmental management practices and conservation efforts. There are approximately 79 golf courses in the Schuylkill River watershed, covering almost 12,000 acres, with over 21 miles of stream running through them. Golf courses are also the single largest privately owned pieces of land in the watershed, making it extremely important that they practice environmentally-sound land management. By encouraging environmentally sensitive turf management, establishing streambank vegetation and no-mow zones, avoiding toxic pesticides and herbicides, and minimizing nutrient loads on the golf course, the SAN hopes to provide the tools necessary to reduce nutrient loadings and toxic chemicals from pesticides and herbicides into the watershed, while promoting biodiversity through increased habitat.

School Awards and Certification Program

In this program, students will submit applications outlining activities their schools have implemented within the previous calendar year to protect wetlands, reduce erosion, filter runoff, conserve water, or improve fertilizer or pesticide practices. Applications will be assessed according a specific set of criteria, with the schools that best satisfy the criteria receiving the award. The award program will act as an incentive for schools to participate in a subsequent certification program, which will offer an educational workshop for interested schools related to watershed protection and improvement of housekeeping practices.

3.3.6 Perkiomen Creek Subwatershed Initiative

The Perkiomen Creek subwatershed was identified as an area of particular concern during the source water assessments and has come up again during the prioritization of potential sources within this protection plan, specifically the areas within the Lower Perkiomen subwatershed. According to the U.S. Census, this subwatershed experienced the largest increase in population between 1990 and 2000 with over 40,000 new residents in this 366 square mile area. The following projects will be implemented by the Perkiomen Watershed Conservancy, a SAN member, through funds provided by Aqua America, Inc. and the EPA Watersheds Initiative Grant.

Green Lane Reservoir Restoration

The Green Lane Reservoir is owned and operated by Aqua America, Inc. and is located near the headwaters of the Perkiomen Creek. The reservoir's preserved riparian areas are managed by the Montgomery County Parks Department. Green Lane Reservoir serves to augment flows in the Perkiomen Creek, where Aqua America withdraws drinking water downstream. This project would reforest several acres of the watershed upstream of the Green Lane Reservoir, helping to stabilize soils and absorb runoff and protect the water quality for the reservoir. In addition, the Green Lane Reservoir is considered impaired by PADEP, and a TMDL study is currently underway.

Hosensack Creek Restoration

This project is located on a Pennsylvania Power & Light easement on fish and game club property and farm, located in Lower Milford Township, Lehigh County. Project goals include stream buffer fencing and re-establishment of native riparian vegetation to stabilize banks and prevent further erosion from occurring. Project tasks include obtainment of necessary permits, development of a planting plan based on soil characteristics and topography, evaluation of riparian zone shrub and tree community structure in naturally vegetated areas of the creek, selection of native plant species for the riparian buffer, and planting according to established plan. Hosensack Creek drains to the Green Lane Reservoir, which is considered impaired by PADEP.

Perkiomen Subshed Outreach Pilot

Perkiomen Watershed Conservancy and Aqua America initiated the Perkiomen Subwatershed Initiative (SWI) in 2003. This is a multi-year conservation, education, and clean-up program addressing specific needs of six subwatersheds that comprise the Perkiomen watershed. Outreach efforts include: signage for restoration projects along the Perkiomen; implementation by community volunteers of major components of stream cleanups and restoration projects; public outreach focusing on status of watershed projects in the form of newsletters, public meetings, and a watershed conference; implementation of watershed education curriculum in middle schools in the watershed; implementation of existing watershed curriculum in early childhood education programs; stormwater education aimed at municipal officials, engineers and developers that encourages naturalization of water basins and better design of new stormwater management facilities, and outreach to the Perkiomen agricultural community regarding total maximum daily load requirements for treatment plants in the subshed.

Rambo Park

This project is located at the headwaters of an unnamed tributary to Donny Brook Run, which flows directly into the Perkiomen Creek. Project goals include re-establishment of the stream's riparian buffer and wetland areas of Rambo Park and installation of educational signs. The project site is located on Trappe Borough property, which was recently preserved as parkland. The Rambo Park project is set to be a focal point in the park's passive recreation master plan.

Scioto Creek Restoration

This project is located on Upper Frederick Township property along an unnamed tributary to the Scioto Creek (a tributary of Swamp Creek). The project will include removal of invasive plant species, establishment of a small wetland to intercept runoff prior to discharge to the stream channel, and preservation of existing trees and native shrubs in order to reduce erosion and enhance habitat diversity.

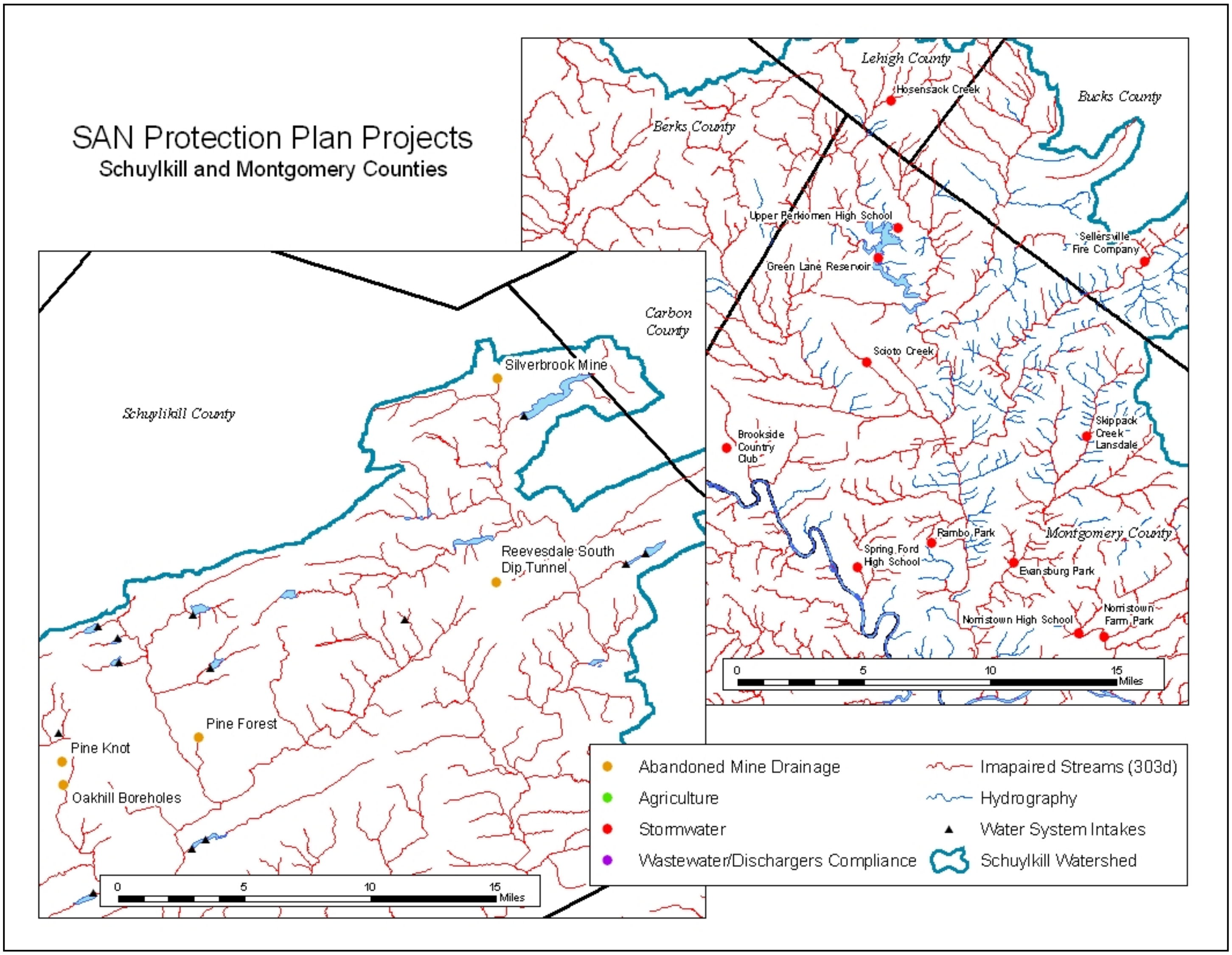
Sellersville Fire Company

The East Branch Perkiomen Creek at this site has a stream bank erosion problem exacerbated by stormwater runoff from adjacent impervious surfaces and by poor stream bank vegetative cover resulting from regular mowing and overgrazing by Canada geese. This project will restore and enhance a portion of the 500-foot stream length with a three-zone riparian buffer. The project includes obtainment of necessary permits, development of a planting plan based on soil characteristics and topography, evaluation of riparian zone shrub and tree community structure in naturally vegetated areas of the creek, selection of native plant species for the riparian buffer, and planting according to the established plan.

Skippack Creek (Evansburg Park)

This portion of the Skippack Creek is experiencing severe streambank erosion caused by runoff from roads at the Lansdale interchange of the Pennsylvania Turnpike. This project will establish several stormwater BMPs to address the runoff originating from the PA-Turnpike, restore floodplain access, and stabilize banks.

Figure 3.3.6-1 Locations of SAN Construction Projects in the Schuylkill River Watershed



3.4 PWD & SAN Source Water Protection Projects

Table 3.4-1 Project Name, Location, and Description

Abandoned Mine Drainage			
Project Name	**Subwatershed**	**County**	**Project Description**
Pine Forest	Mill Creek	Schuylkill	anoxic limestone drain and aerobic wetland treatment system
Pine Knot	West Branch Schuylkill River	Schuylkill	AMD treatment system for largest AMD discharge in the watershed
Reevesdale South Dip Tunnel	Wabash Creek	Schuylkill	oxic limestone drain and aerobic wetland treatment system
Oakhill Boreholes	West Branch Schuylkill River	Schuylkill	treatment feasibility study
Silverbrook Mine	Little Schuylkill River	Schuylkill	treatment feasibility study
Stormwater			
Project Name	**Subwatershed**	**County**	**Project Description**
Bells Mill Run at Cathedral Road Plunge Pool	Wissahickon Creek	Philadelphia	Reduce pooling and erosion through redesign of plunge pool
Belmont Meadow Extension	Lower Schuylkill River	Philadelphia	fencing and revegetation to decrease geese activity near PWD intake
Carpenter's Woods	Wissahickon Creek	Philadelphia	FGM design for two stream channels and stormwater wetland construction
Courtesy Stables	Wissahickon Creek	Philadelphia	stormwater routing into grassed filter strip; educational signage
E&S Inspector Program	Lower Schuylkill/Wissahickon	Philadelphia	hire E&S inspector for City construction projects
Gorgas Lane Plunge Pool	Wissahickon Creek	Philadelphia	Reduce pooling and erosion through redesign of plunge pool
Lansdale Borough	Wissahickon Creek	Montgomery	outfall infiltration
Livezy Dam Removal	Wissahickon Creek	Philadelphia	Removal of dam to decrease detrimental water quality impacts from "ponding"
Manayunk Canal Aeration	Lower Schuylkill River	Philadelphia	surface aeration to increase dissolved oxygen levels
Monestary Stables	Wissahickon Creek	Philadelphia	construction of stormwater management controls
Norristown Farm Park	Stony Creek	Montgomery	invasive species removal study
Norristown High School	Stony Creek	Montgomery	infiltrate parking lot runoff
Sandy Run Act 167 Plan	Wissahickon Creek	Montgomery	Development of an Act 197 Plan
Saylor Grove	Wissahickon Creek	Philadelphia	construction of a 1-acre stormwater wetland
Skippak Creek (Evansburg Park)	Skippak Creek	Montgomery	streambank restoration
Stormwater Regulations Development	Lower Schuylkill & Wissahickon	Philadelphia	revise and adopt current ordinance and add redevelopment component
Technical Assistance for Schools	Wissahickon Creek	Philadelphia	technical assistance for two conceptual designs for BMPs

W.B Saul High School	Wissahickon Creek	Philadelphia	cattle crossings, cattle fencing, riparian buffer construction
Wissahickon Detention Basin Study	Wissahickon Creek	Montgomery	feasibility analysis for BMPs
Wissahickon Feasibility Study	Wissahickon Creek	Philadelphia/Montgomery	evaluate all reasonable options for improving water quality in the Wissahickon
Brookside Country Club	Sprogels Run	Montgomery	removal of dam and streambank restoration
Green Lane Reservoir Restoration	Perkiomen Creek	Montgomery	riparian buffer restoration
Land Preservation Study	various	Montgomery	identify and prioritize parcels for preservation based on source water protection
Spring-Ford High School	Middle Schuylkill	Montgomery	stormwater detention basin naturalization
Watershed Wide Act 167 Plan Study	various	all	assess degree of protection afforded by plans
Hosensack Creek Restoration	Perkiomen Creek	Montgomery	streambank restoration and riparian buffer installation
Rambo Park	Perkiomen Creek	Montgomery	re-establishment of riparian buffer and installation of educational signage
Scioto Creek Restoration	Perkiomen Creek	Montgomery	installation of small wetland, removal of invasive plant species
Sellersville Fire Company	East Branch Perkiomen Creek	Bucks	streambank restoration
Upper Perkiomen High School	Perkiomen Creek	Montgomery	infiltrate parking lot runoff

Wastewater Dischargers/Compliance

Project Name	**Subwatershed**	**County**	**Project Description**
Act 537 Planning Workshop	all	various	workshop to encourage implementation of 537 plan
Bacteria Source Tracking	Wissahickon Creek	Philadelphia/Montgomery	program will focus initially on *Cryptosporidium*
Infectivity/Viability Study	all	various	assess the impacts of UV on *Cryptosporidium*
On-Line Monitoring at WTP Intakes	Lower Schuylkill River	Philadelphia	expansion of real-time monitoring network
Point Source Ground-truthing	all	various	verify potential sources of contamination identified as priority locations
Regional WWTP in Upper Schuylkill	Upper Schuylkill	Schuylkill	construction of a 550,000 gallon per day treatment plant in the Upper Schuylkill subwatershed
Sewage Facility Self Assessment Program	all	various	self evaluation program of sewage facility operations
Wissahickon/Monoshone Defective Laterals Program	Wissahickon Creek	Philadelphia	loan program for help with remediation of defective laterals
Cryptosporidium Monitoring Requirement	various	various	add *Cryptosporidium* monitoring or UV treatment to priority discharger permits
Dobson's Run Elimination	Lower Schuylkill River	Philadelphia	CSO Control - removal of two intercepting chambers
Early Warning System Reporting	various	various	Developing process/procedure for PADEP Regional Emergency Response personnel to utilize EWS notification for appropriate incidents/events
Main and Shurs Elimination	Lower Schuylkill River	Philadelphia	CSO Control - removal of relief overflow
Pollutant Trading Study	various	various	use of innovative technologies to initiate pollutant trading programs

Agriculture			
Project Name	**Subwatershed**	**County**	**Project Description**
Conservation Plan	Tulpehocken, Maiden	Berks, Lebanon, Schuylkill	develop 50 farm conservation plans
Erdenheim Farms	Wissahickon Creek	Montgomery	acquisition of a permanent riparian buffer on an active farm
Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing & Cattle Crossing Installation	Tulpehocken, Maiden	Berks, Lebanon, Schuylkill	identify contiguous farms for streambank fencing projects, vegetative planting to reduce impacts of nutrient and phosphorus runoff, and installation of streambank fencing and cattle crossings

Education/Outreach			
Project Name	**Subwatershed**	**County**	**Project Description**
Farm Awards and Certification	various	various	farmer education program on best management practices
Golf Course Certification	various	various	stormwater management certification for golf course managers
Perkiomen Subshed Outreach Pilot	various	Montgomery	education and outreach support of PWC Perkiomen SWI-demonstration
Philly RiverCast	Lower Schuylkill/Wissahickon	Philadelphia	web based tool to forecast water quality that predicts potential levels of pathogens in the Schuylkill River between Flat Rock Dam and Fairmount Dam
School Awards and Certification	various	various	establish stormwater management certification program for schools
Waterways Restoration Team	Lower Schuylkill/Wissahickon	Philadelphia	monitor activity near streams and remove debris
Clean Water Partners	various	various	establish CWP programs with businesses throughout the watershed
Environmental Advisory Councils (EACs)	various	various	creation of EACs in high priority areas
Watershed Information Center	various	various	web based regional resource of Southeastern Pennsylvania watershed-related information

Table 3.4-2 Project Cost, Partners, and Priority Score

Abandoned Mine Drainage						
Project Name	**Estimated Project Cost**	**Project Partners**	**SWPP Priority Subshed**	**303(d) impaired**	**TMDL**	**Remediation/Implementation Priority Score**
Pine Forest	$943,586	SHA, SCCD	Y*	Y	N	HIGH
Pine Knot	$5,000,000	SHA, SCCD	Y*	Y	N	HIGH
Reevesdale South Dip Tunnel	$438,496	SHA, SCCD	Y*	Y	Y	HIGH
Oakhill Boreholes	$46,000	SHA, SCCD	Y*	Y	N	MODERATE
Silverbrook Mine	$51,500	SHA, SCCD	Y*	Y	N	MODERATE
Stormwater						
Project Name	**Estimated Project Cost**	**Project Partners**	**SWPP Priority Subshed**	**303(d) impaired**	**TMDL**	**Remediation/Implementation Priority Score**
Bells Mill Run at Cathedral Road Plunge Pool	$400,000	PWD	Y	Y	Y	HIGH
Belmont Meadow Extension	$8,000	PWD, FPC	Y	Y	N	HIGH
Carpenter's Woods	$250,000	PWD	Y	Y	Y	HIGH
Courtesy Stables	$50,000	PWD, FPC, NRCS	N	Y	Y	HIGH
E&S Inspector Program	$50,000	PWD	Y	Y	Y	HIGH
Gorgas Lane Plunge Pool	$400,000	PWD	Y	Y	Y	HIGH
Lansdale Borough	$85,000	BOL, WVWA	Y	Y	Y	HIGH
Livezy Dam Removal	$250,000	PWD	N	Y	Y	HIGH
Manayunk Canal Aeration	$5,000	PWD, FPC	Y	Y	N	HIGH
Monestary Stables	$50,000	PWD, FPC	Y	Y	Y	HIGH
Norristown Farm Park	$25,000	SCA, MCCD	Y	Y	N	HIGH
Norristown High School	$100,000	NSD, SCA	Y	Y	N	HIGH
Sandy Run Act 167 Plan	$10,000	MCPC	Y	Y	Y	HIGH
Saylor Grove	$450,000	PWD, FPC, PADEP	N	Y	Y	HIGH
Skippak Creek (Evansburg Park)	$50,000	AA, PWC	Y	Y	N	HIGH
Stormwater Regulations Development	$50,000	PWD, municipalities	Y	Y	Y	HIGH
Technical Assistance for Schools	$50,000	PWD, PADEP	Y	Y	N	HIGH
W.B Saul High School	$50,000	PWD, PSD	N	Y	Y	HIGH
Wissahickon Detention Basin Study	$10,000	PWD, WVWA	Y	Y	Y	HIGH
Wissahickon Feasibility Study	$1,500,000	PWD, ACOE	Y	Y	Y	HIGH
Brookside Country Club	$25,000	Delaware Riverkeeper	Y	N	N	MODERATE
Green Lane Reservoir Restoration	$133,200	AA, PWC	Y	N	Y	MODERATE

Land Preservation Study	$20,000	PWD, NLT	N/A	N/A	N/A	MODERATE
Spring-Ford High School	$15,000	MCCD, FMC	Y	N	N	MODERATE
Watershed Wide Act 167 Plan Study	$15,000	PEC, counties	N/A	N/A	N	MODERATE
Hosensack Creek Restoration	$8,500	PWC, AA, EGWD	N	N	N	MODERATELY LOW
Rambo Park	$4,000	PWC, AA, EGWD	N	N	N	MODERATELY LOW
Scioto Creek Restoration	$5,000	PWC, AA, EGWD	N	N	N	MODERATELY LOW
Sellersville Fire Company	$14,300	BOS, AA	N	N	N	MODERATELY LOW

Wastewater Dischargers/Compliance

Project Name	**Estimated Project Cost**	**Project Partners**	**SWPP Priority Subshed**	**303(d) impaired**	**TMDL**	**Remediation/Implementation Priority Score**
Act 537 Planning Workshop	$2,000	EPA, municipalities	Y	Y	Y	HIGH
Bacteria Source Tracking	$50,000	VU, PWD	Y	Y	Y	HIGH
Infectivity/Viability Study	$75,000	PWD	N/A	N/A	N/A	HIGH
On-Line Monitoring at WTP Intakes	$5,000	municipalities, Schuylkill County	Y	Y	N	HIGH
Point Source Ground-truthing	$8,000	EPA, PADEP	N/A	N/A	N/A	HIGH
Regional WWTP in Upper Schuylkill	$20,000,000	PADEP, PENNVEST, municipalities	Y	Y	N	HIGH
Sewage Facility Self Assessment Program	$2,000	EPA, municipalities	Y	Y	Y	HIGH
Wissahickon/Monoshone Defective Laterals Program	$2,000,000	PWD, COP	Y	Y	Y	HIGH
Cryptosporidium Monitoring Requirement	$3,000	PWD, COP	Y	Y	Y	MODERATE
Dobson's Run Elimination	$18,700,000	PWD, COP	Y	Y	N	MODERATE
Early Warning System Reporting	$3,000	PWD, DRBC, water suppliers	N/A	N/A	N/A	MODERATE
Main and Shurs Elimination	$12,000,000	PADEP, EPA, PWD	Y	Y	N	MODERATE
Pollutant Trading Study	$10,000	EPA, PWD, AWWTP	Y	Y	N	MODERATE

Agriculture

Project Name	**Estimated Project Cost**	**Project Partners**	**SWPP Priority Subshed**	**303(d) impaired**	**TMDL**	**Remediation/Implementation Priority Score**
Conservation Plan	$50,000	BCCD	Y	Y	N	HIGH
Erdenheim Farms	$21,000,000	NLT, WVWA	Y	Y	Y	HIGH
Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing & Cattle Crossing Installation	$510,000	BCCD, USDA, DU, TU, farmers	Y	Y	N	HIGH

Education/Outreach						
Project Name	**Estimated Project Cost**	**Project Partners**	**SWPP Priority Subshed**	**303(d) impaired**	**TMDL**	**Remediation/Implementation Priority Score**
Farm Awards and Certification	$12,500	BCCD	N/A	N/A	N/A	HIGH
Golf Course Certification	$10,000	AI	N/A	N/A	N/A	HIGH
Perkiomen Subshed Outreach Pilot	$126,700	AA, PWC	N/A	N/A	N/A	HIGH
Philly RiverCast	$50,000	PWD	Y	Y	Y	HIGH
School Awards and Certification	$35,000	PDE	N/A	N/A	N/A	HIGH
Waterways Restoration Team	$100,000	PWD, FPC	Y	Y	Y	HIGH
Clean Water Partners	$50,000	PDE	N/A	N/A	N/A	MODERATE
Environmental Advisory Councils (EACs)	$20,000	PEC, municipalities, LOWV	Y	N/A	N/A	MODERATE
Watershed Information Center	$500,000	PWD	N/A	N/A	N/A	MODERATE

Table 3.4-3 Project Implementation Schedule

Abandoned Mine Drainage	Data Collection and Evaluation		Planning and Design		Implementation	
Project Name	Start	End	Start	End	Start	End
Pine Forest	Spring 2005	Spring 2008	Spring 2005	Fall 2005	Summer 2005	Winter 2006
Pine Knot Tunnel	Spring 2005	Spring 2008	Spring 2005	Spring 2007	Spring 2006	Fall 2007
Reevesdale South Dip Tunnel	Spring 2005	Spring 2008	Fall 2006	Spring 2007	Summer 2005	Winter 2006
Oakhill Boreholes	Present	Summer 2010	Summer 2006	Summer 2007	Summer 2007	Winter 2008
Silverbrook Mine	Present	Winter 2008	Fall 2007	Winter 2008	N/A	N/A
Agriculture	**Data Collection and Evaluation**		**Planning and Design**		**Implementation**	
Project Name	Start	End	Start	End	Start	End
Conservation Plans	N/A	N/A	N/A	N/A	Spring 2005	Spring 2008
Erdenheim Farms	N/A	N/A	N/A	N/A	Spring 2005	Fall 2007
Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing & Cattle Crossing Installation	Present	Winter 2005	Spring 2005	Winter 2006	Summer 2005	Summer 2007
Stormwater	**Data Collection and Evaluation**		**Planning and Design**		**Implementation**	
Project Name	Start	End	Start	End	Start	End
Bells Mill Run at Cathedral Road Plunge Pool	Spring 2005	Spring 2007	Spring 2005	Fall 2005	Spring 2006	Fall 2006
Belmont Meadow Extension	Spring 2004	Spring 2007	Spring 2005	Fall 2005	Spring 2006	Summer 2006
Carpenter's Woods	Winter 2005	Fall 2010	Spring 2005	Fall 2007	Spring 2009	Fall 2009
Courtesy Stables	Spring 2004	Fall 2006	Winter 2004	Summer 2004	Fall 2004	Fall 2004
E&S Inspector Program	Spring 2005	ongoing	N/A	N/A	N/A	N/A
Gorgas Lane Plunge Pool	Winter 2005	Fall 2010	Spring 2005	Fall 2007	Spring 2009	Fall 2009
Lansdale Borough	Spring 2005	Spring 2008	Winter 2004	Winter 2006	Spring 2006	Fall 2006
Livezy Dam Removal	Winter 2005	Fall 2010	Spring 2005	Fall 2007	Spring 2009	Fall 2009
Manayunk Canal Aeration	Present	Spring 2008	Winter 2004	Spring 2004	Summer 2005	N/A
Monestary Stables	Winter 2005	Winter 2006	Present	Spring 2005	Spring 2005	Fall 2005
Norristown Farm Park	Spring 2005	Spring 2008	Spring 2005	Spring 2006	Spring 2006	Fall 2006
Norristown High School	Spring 2005	Spring 2008	Winter 2004	Spring 2006	Spring 2006	Fall 2006
Sandy Run Act 167 Plan	Winter 2004	Fall 2006	N/A	N/A	N/A	N/A
Saylor Grove	Present	Spring 2008	complete	complete	Spring 2005	Fall 2005
Skippack Creek (Evansburg Park)	Spring 2005	Spring 2008	Spring 2006	Spring 2007	Summer 2007	Fall 2007
Stormwater Regulations Development	complete	complete	N/A	N/A	Summer 2005	ongoing
Technical Assistance to Schools	N/A	N/A	Fall 2005	Summer 2007	N/A	N/A
W.B. Saul High School	Winter 2005	Summer	Spring 2005	Spring 2006	Spring 2006	Summer 2006

		2007				
Wissahickon Detention Basin Study	Winter 2005	Summer 2007	Spring 2006	Winter 2007	N/A	N/A
Wissahickon Feasibility Study	Winter 2005	Fall 2006	Spring 2005	Spring 2007	N/A	N/A
Brookside Country Club	Spring 2005	Spring 2008	Complete	Complete	Spring 2005	Fall 2005
Green Lane Reservoir Restoration	Winter 2005	Summer 2007	Spring 2005	Spring 2006	Spring 2006	Summer 2007
Land Preservation Study	Present	Fall 2005	N/A	N/A	N/A	N/A
Spring-Ford High School	Spring 2005	Spring 2008	Present	Spring 2005	Spring 2005	Fall 2005
Hosensack Creek Restoration	Winter 2005	Summer 2007	Spring 2005	Spring 2006	Spring 2006	Summer 2007
Rambo Park	Winter 2005	Summer 2007	Spring 2005	Spring 2006	Spring 2006	Summer 2007
Scioto Creek Restoration	Winter 2005	Summer 2007	Spring 2005	Spring 2006	Spring 2006	Summer 2007
Sellersville Fire Company	Winter 2005	Summer 2007	Spring 2005	Spring 2006	Spring 2006	Summer 2007
Wastewater Dischargers/Compliance	**Data Collection and Evaluation**		**Planning and Design**		**Implementation**	
Project Name	Start	End	Start	End	Start	End
Act 537 Planning Workshop	N/A	N/A	Complete	Complete	Winter 2005	Winter 2005
Bacteria Source Tracking	N/A	N/A	Fall 2004	Fall 2005	Fall 2005	N/A
Infectivity/Viability Study	Winter 2005	Winter 2006	N/A	N/A	N/A	N/A
On-line Monitoring at WTP Intakes	N/A	N/A	N/A	N/A	Present	Winter 2006
Point Source Ground-Truthing	Present	Spring 2008	N/A	N/A	Spring 2005	Spring 2008
Regional WWTP in Upper Schuylkill	Present	Summer 2006	Fall 2006	Fall 2007	Spring 2008	Summer 2010
Sewage Facility Self-Assessment Program	N/A	N/A	Present	Winter 2005	Spring 2005	Spring 2006
Wissahickon/Monoshone Defective Laterals Program	ongoing	ongoing	N/A	N/A	Spring 1998	ongoing
Cryptosporidium Monitoring Requirement	Fall 2005	Spring 2008	N/A	N/A	Summer 2008	Summer 2010
Dobson's Run Elimination	Complete	Complete	Complete	Complete	Summer 2005	Fall 2007
Early Warning System Reporting	N/A	N/A	Winter 2005	Summer 2005	Spring 2005	ongoing
Main & Shurs Elimination	Complete	Complete	Complete	Complete	Spring 2006	Summer 2007
Pollutant Trading Study	N/A	N/A	Spring 2005	Spring 2006	Spring 2006	Fall 2006

Education/Outreach	**Data Collection and Evaluation**		**Planning and Design**		**Implementation**	
Project Name	Start	End	Start	End	Start	End
Farm Awards & Certification	Spring 2005	Spring 2008	Spring 2005	Fall 2005	Spring 2006	Spring 2006
Golf Course Certification	Spring 2005	Spring 2008	NA	NA	Spring 2005	Fall 2008
Perkiomen Sub-Shed Outreach Pilot	Spring 2005	Spring 2008	NA	NA	Spring 2005	Spring 2008
Philly RiverCast	Spring 2005	Spring 2005	Spring 2005	Summer 2005	Summer 2005	ongoing
School Awards & Certification	Spring 2005	Spring 2008	Fall 2005	Spring 2006	Spring 2006	Fall 2006
Clean Water Partners	N/A	N/A	Winter 2005	Winter 2005	Winter 2005	Winter 2006
Environmental Advisory Councils	Spring 2005	Spring 2008	Fall 2004	Summer 2005	Summer 2004	Fall 2006
Watershed Information Center	Winter 2005	Spring 2005	Spring 2005	Summer 2005	Summer 2005	ongoing

Table 3.4-4 List of Project Partners

AA	Aqua America
ACOE	Army Corps of Engineers
AI	Audubon International
AWWTP	Abington Waste Water Treatment Plant
BCCD	Berks County Conservation District
BOL	Borough of Lansdale
COP	City of Philadelphia
DRBC	Delaware River Basin Commission
DU	Ducks Unlimited
EGWD	East Greenville Borough Water Department
EPA	U.S. Environmental Protection Agency
FPC	Fairmount Park Commission
FMC	Friends of Mingo Creek
LOWV	League of Women Voters
MCPC	Montgomery County Planning Commission
NLT	Natural Lands Trust
NSD	Norristown School District
PADEP	Pennsylvania Department of Environmental Protection
PDE	Partnership for the Delaware Estuary
PEC	Pennsylvania Environmental Council
PWC	Perkiomen Watershed Conservancy
PWD	Philadelphia Water Department
SCA	Stony Creek Anglers
SCCD	Schuylkill County Conservation District
SHA	Schuylkill Headwaters Association
TU	Trout Unlimited
UPSD	Upper Perkiomen School District
USDA	United States Department of Agriculture
VU	Villanova University
WVWA	Wissahickon Valley Watershed Association

Section 4. Funding and Public Outreach

4.1 Funding Sources in the Schuylkill River Watershed

4.1.1 Funding Allocations

The projects outlined in the previous section represent the strategy for addressing the priority point and non-point pollution sources identified in Section 3.1.3. As discussed, the SAN is the primary means through which those projects will be implemented. Integral to the success of the SAN, and thus to the implementation of the strategy, is the securing of funding for project execution. Between 1998 and 2002, approximately $20 million in grant awards were allocated to the Schuylkill River watershed. PWD and other key SAN members were awarded some of this funding and will continue to seek additional funding for the implementation of restoration and educational projects.

Figure 4.1.1-1 shows the total dollar awards and the organization or program that awarded the funds to various projects in the Schuylkill watershed from 1998-2002. Figure 4.1.1-2 shows the amount of money spent on specific types of activities within the watershed during this same time period.

Figure 4.1.1-1 Total Funding Allocated to the Schuylkill River Watershed (1998-2002)

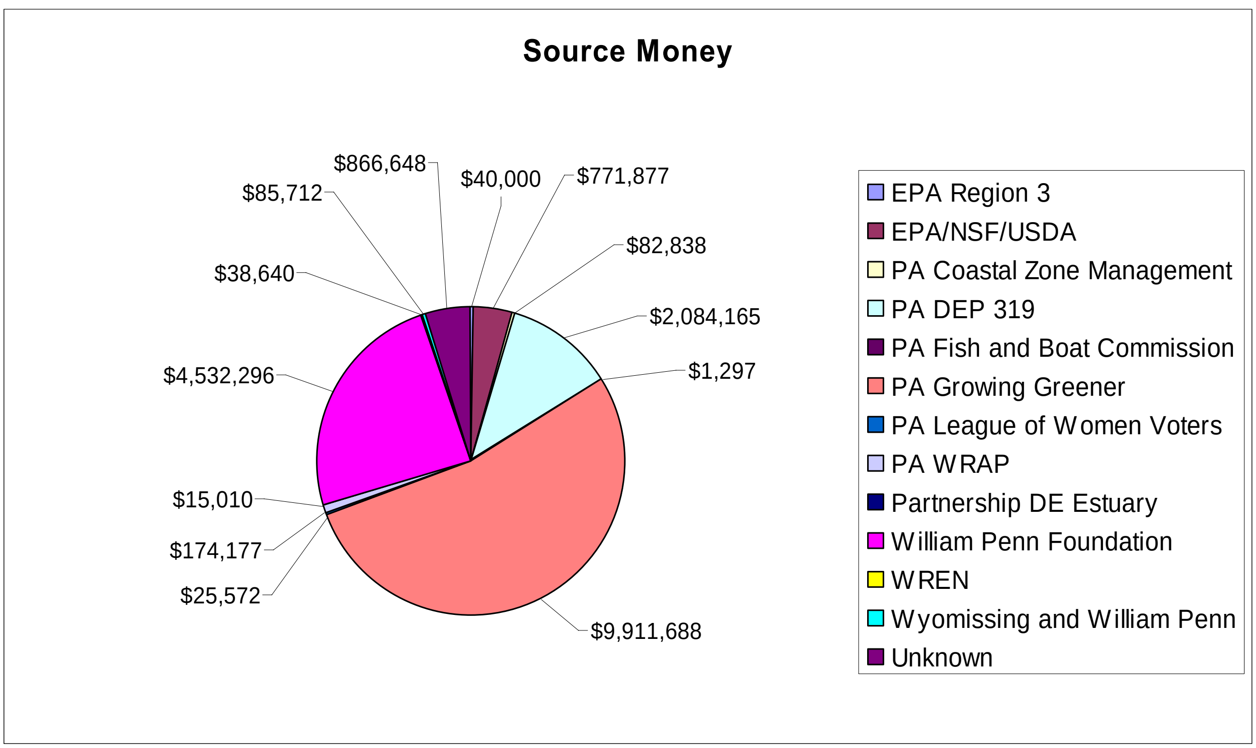
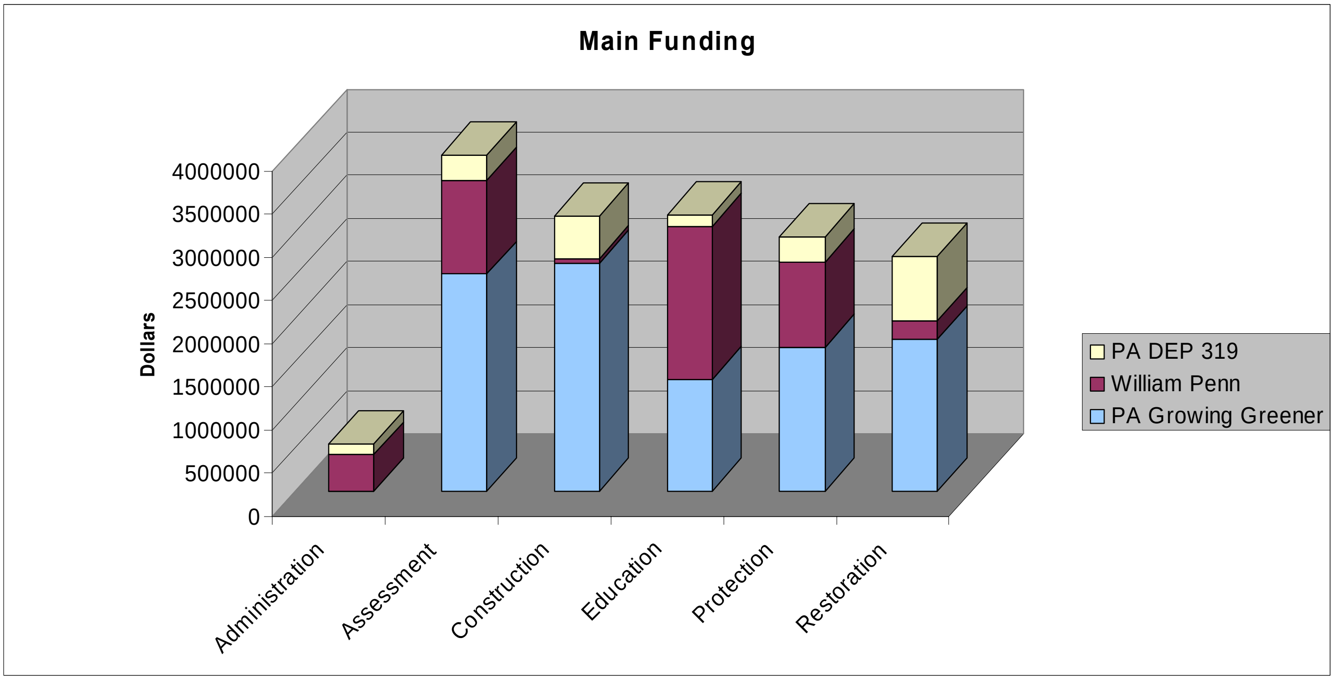


Figure 4.1.1-2 Total Dollar Amounts Spent on Specific Activities in the Schuylkill River Watershed



Between 1998 and 2002 the Lower Schuylkill subwatershed had the highest level of funding from 1998-2002, while the Allegheny subwatershed had the lowest. Figure 4.1.1-3 shows a complete comparison of the watersheds.

Figure 4.1.1-3 Distribution of Grant Dollars within the Schuylkill River Subwatersheds

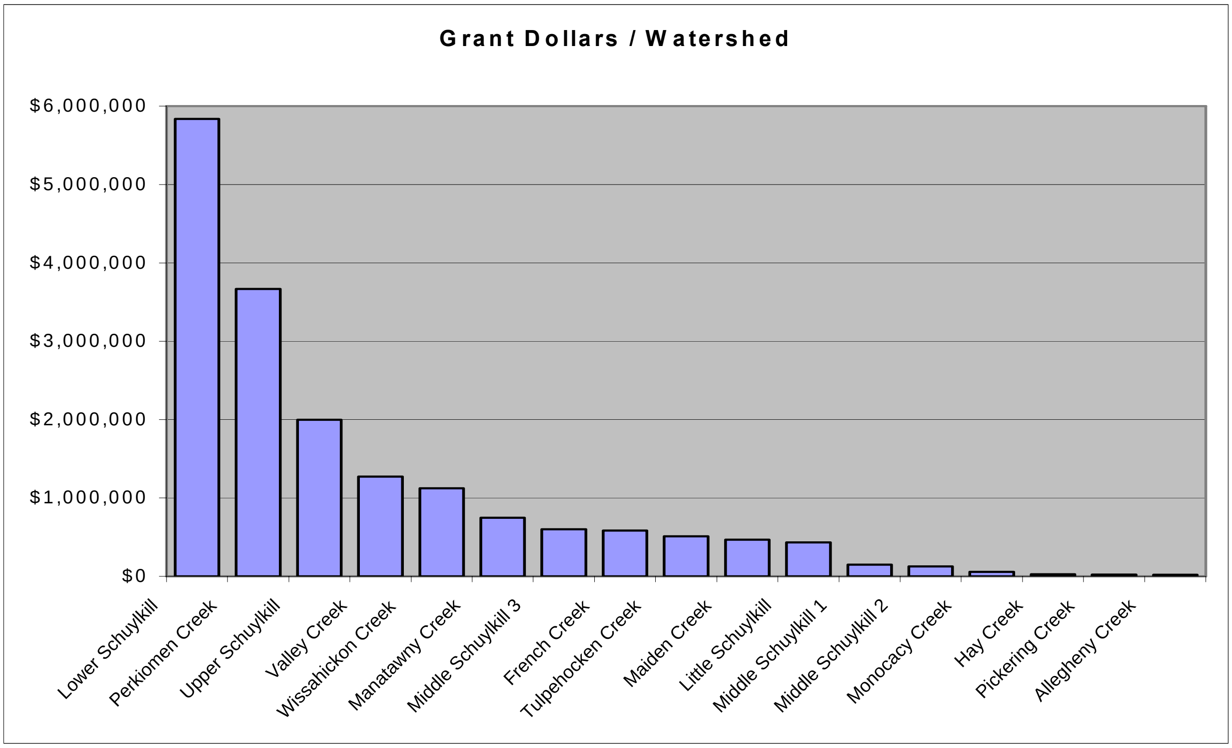
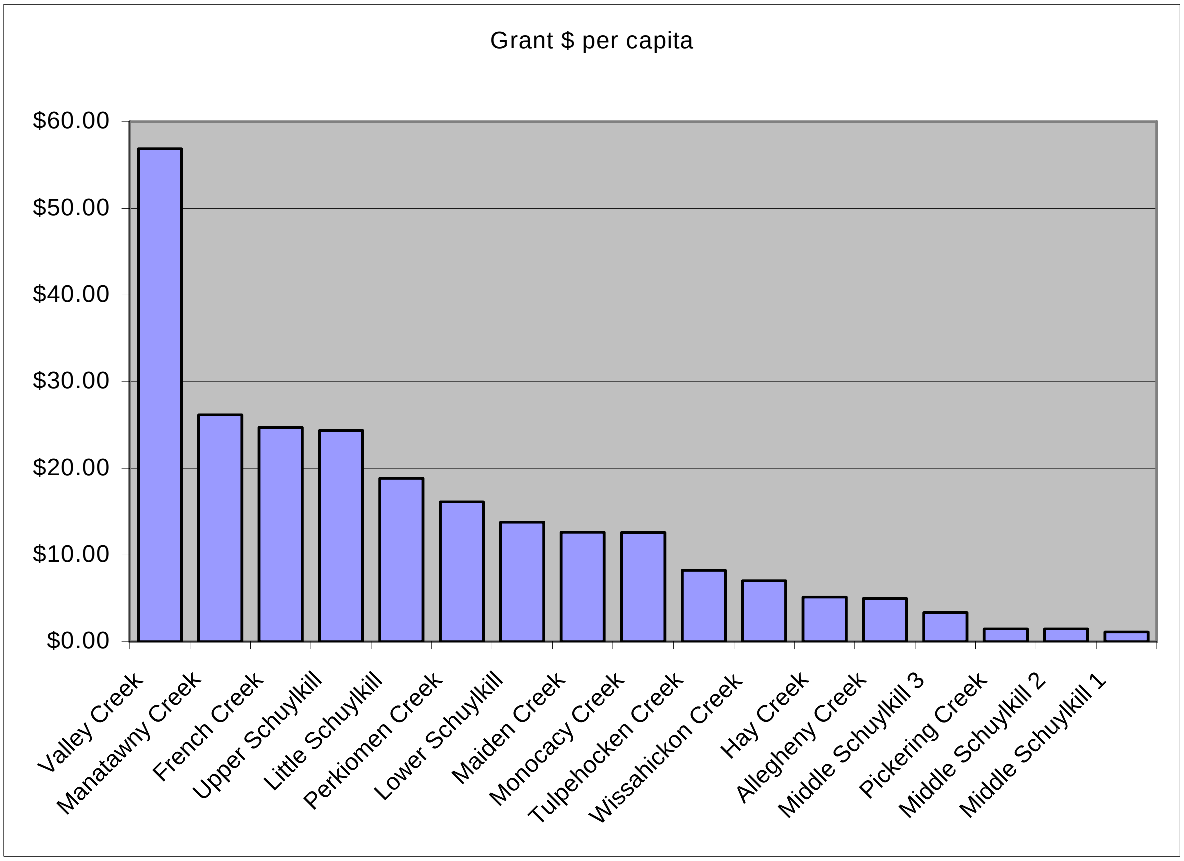


Figure 4.1.1-4 shows the grant dollars broken up by dollars per capita for each subwatershed. The Valley Creek subwatershed ranked number one in terms of grant dollars per capita, with a total of $56.88 awarded per capita. This watershed was the recipient of a large research grant awarded by the National Science Foundation and the Environmental Protection Agency to Drexel University to study the effects of suburban sprawl on water resources. The watershed with the lowest funding was the Middle Schuylkill One, with a $1.12 per capita. The other mainstem drainage basins, named Middle Schuylkill Two, and Middle Schuylkill Three, also scored very low in this category. This situation reflects the current organizational status of environmental stewards within the Schuylkill River watershed. Most of the environmental groups are focused on the watersheds or main tributaries to the river, with very little civic focus on the mainstem of the river itself.

Figure 1.6-2 Grant Money per Capita Awarded within each Schuylkill River Subwatershed



4.1.2 Sources of Funding

In order to implement the projects identified in this protection plan, PWD in partnership with the SAN will seek funds from several sources, including EPA's Watershed Initiative and Regional Geographic Initiative grants, PADEP's Growing Greener Program, William Penn Foundation, Exelon Corporation, and Congressional Farm Bill Appropriations.

Watersheds Initiative Grant

The Watersheds Initiative Grant is an annual EPA competitive grant program in which approximately $20 million are distributed among 20 watershed programs throughout the country. Award applications, which must have approval of the state governor, are evaluated based on innovation, measurement of environmental results, broad support, active involvement of more than one governmental entity, and breadth of the outreach program. Applications which adhere most to these tenets, and which therefore demonstrate the most promising watershed-based approaches to water quality, are selected as award recipients. In June 2004, the SAN was selected as the recipient of $1,149,340 from the Watersheds Initiative Grant program. These funds are the primary means through which SAN projects will be executed and project outcomes and results measured. Grant stipulations require that funds be spent over the next consecutive three years, and that projects produce short-term measurable results or test new and innovative approaches to water quality. SAN members have committed to providing almost $1,000,000 in matching funds for the Watershed Initiative Grant. Examples of matching funds include funds and in-kind services by PWD for grant administration, monitoring, technical support, and outreach/education efforts, a $200,000 commitment from PADEP for implementation of an abandoned mine drainage control project, and funds totaling $200,000 from other water suppliers in the watershed.

Regional Geographic Initiative

Additionally, SAN members submitted applications for several projects to EPA's Regional Geographic Initiative (RGI), which distributes funds intended to be used as "seed" money for furthering strategic initiatives. RGI funds will be distributed to those projects that best satisfy the following criteria: 1) adherence to at least one of the "Regional Strategic Opportunities", which include watershed restoration, reducing environmental exposure to sensitive populations, and enhancing environmentally responsible development, 2) clearly stated measurable goals and objectives, 3) demonstration of financial commitments by multiple stakeholders, and 4) demonstration of a budget emphasizing how federal funds will be used to effectively execute project goals.

The SAN will also look outside EPA grants to secure funding for protection strategy implementation.

Exelon Corporation

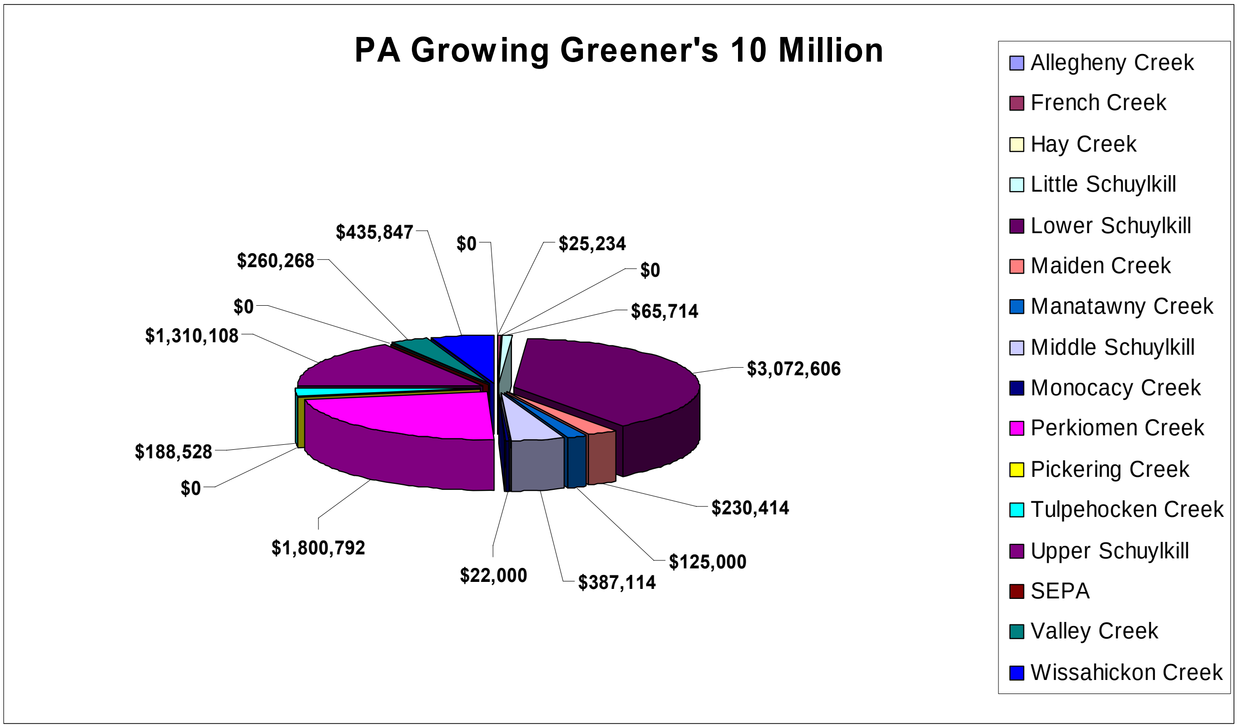
The SAN is also looking to the energy industry, specifically the Exelon Corporation, to implement its protection strategy. Exelon obtains a majority of the water required for its Limerick nuclear power plant operations from the mainstem of the Schuylkill. As a means of maintaining dissolved oxygen levels required for survival of aquatic life, the Delaware River Basin Commission (DRBC) currently requires that when water temperatures at Limerick's Schuylkill intake are above 59˚F, Exelon must stop taking water from this location and instead import water from other sources. Exelon argues that this protocol does not offer the environmental benefits anticipated by DRBC. Exelon further argues that if the temperature requirement were lifted, the company would commit funds saved from reduced costs associated with importing water to environmental projects that have a more positive impact on water quality. While Exelon is currently in negotiations with DRBC to implement changes to its operational requirements, SAN stakeholders are working to ensure that any potential funds from Exelon are designated toward SAN projects.

Growing Greener

Pennsylvania's Growing Greener Program, signed into law by Governor Tom Ridge in 1999, committed approximately $650 million over a period of five years toward preserving farmland and open space, cleaning up abandoned mines and restoring watersheds, and providing new and upgraded water and sewage systems. In June 2002, Governor Mark Schweiker extended the growing greener program through 2012. Facing a tight economy, however, the Growing Greener program will receive 21% less funds next year than what was made available to the program this year. As a means to not only supplement the Growing Greener Fund, but also expand it, Governor Edward Rendell has proposed the Growing Greener II program. The proposed spending would be funded by raising fees on garbage dumping, adding a dumping fee on industrial waste, and adding a fee on release of toxic chemicals to the environment.

Between 1999 and 2002, the Growing Greener Program has allocated approximately $10 million to primarily construction and assessment projects throughout the Schuylkill watershed (see Figure 4.1.2-1). In light of Growing Greener's past history supporting watershed restoration projects, and of the governor's plans to expand the program, the SAN will seek funds for strategy implementation by submitting applications through the competitive Growing Greener grant process. Grants are expected to be distributed once per year in amounts ranging from approximately $4,000 to over $1,000,000.

Figure 4.1.2-1 Growing Greener Funding Allocations by Subwatershed (1999-2002)



PADEP Section 319

This source of funding is appropriated by Congress through the Clean Water Act for projects which address non-point source pollution. PADEP administers the 319 funding program through its Growing Greener program.

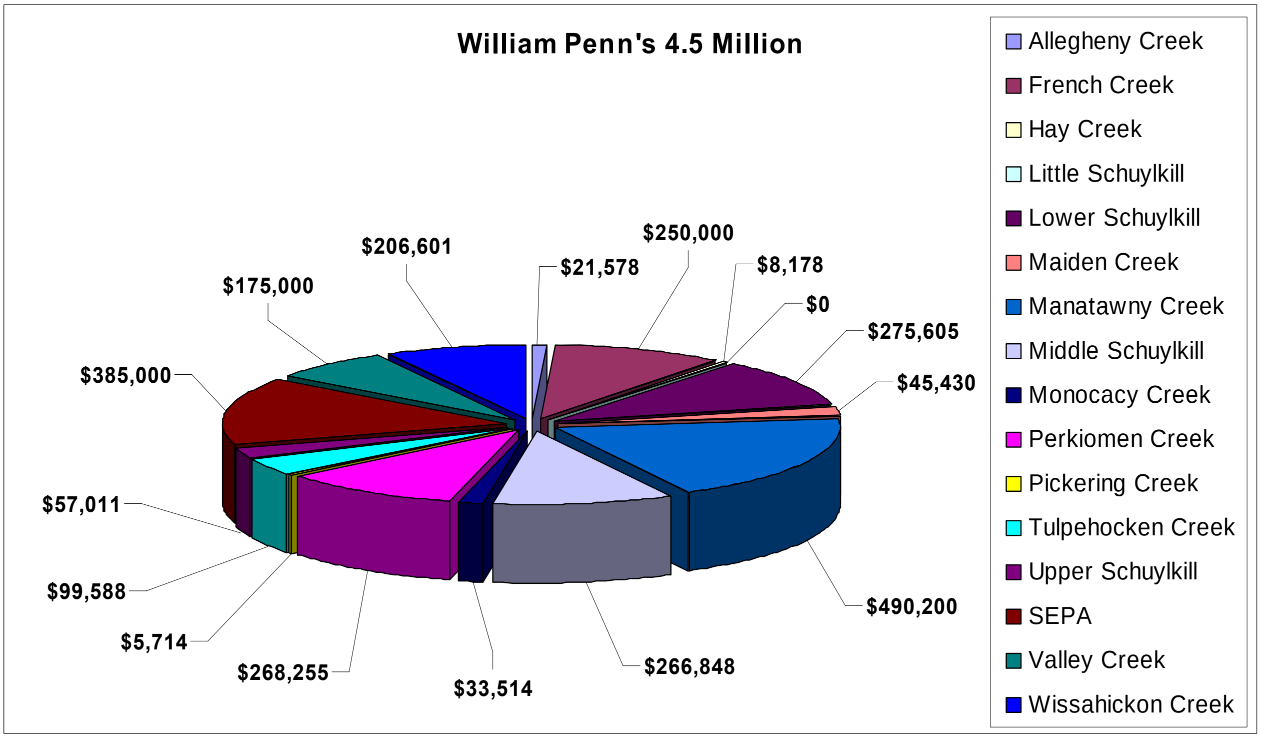
Watershed Protection and Flood Prevention Act (P.L. 83-566)

SAN members also seek funds from Congressional appropriations for protection strategy implementation through the Watershed Protection and Flood Prevention Act (P.L. 83-566). During 2004, the Berks County Conservation District (BCCD) received a $1 million Congressional earmark for projects that address watershed degradation due to agricultural practices in the Tulpehocken Creek subwatershed. Tulpehocken Creek drains into Blue Marsh Lake and into the Schuylkill River. It is also the source water for Western Berks Water Authority and an area of highest protection priority based upon the results of PWD's prioritization results. The SAN will use the funds requested under this appropriation to implement restoration projects as prioritized by the SAN Agriculture Workgroup and this protection plan. Typical restoration projects include streambank fencing, cattle crossings, riparian buffer plantings and the completion of farm conservation plans.

William Penn Foundation

The SAN intends to seek funds through William Penn Foundation's Environment and Communities sector, whose funding priorities include promotion of sustainable watershed assets. The Foundation has historically shown a particular interest in the Schuylkill watershed, which it considers "critical in shaping the growth and development of Greater Philadelphia". The funding goal of the William Penn Foundation is "to promote vital communities within a healthy regional ecosystem". The Foundation works to meet this goal by providing funds to improve the region's watershed resources through land preservation, policy development, and the implementation and construction of various demonstration projects. The William Penn Foundation has long recognized the importance of the Schuylkill River watershed within the Philadelphia Region. Between 1998 and 2002, the Foundation granted over $4.5 million in funding for mostly educational and assessment projects in the watershed (see Figure 4.1.2-2). In 2004, the Foundation instituted two-step competitive application process, including submittal of an inquiry letter, followed by completion of a full proposal upon official invitation by the Foundation. Several members of the SAN submitted letters of inquiry, and a few of those were asked to submit full proposals.

Figure 4.1.2-2 William Penn Foundation Funding Allocations by Subwatershed (1998-2002)



Protection and Restoration Fund and Project Bank

While the SAN will continue to submit grant applications and explore various funding options, the group is currently working to establish a long term, sustainable protection and restoration fund and project bank. Currently, funds to protect, preserve, and restore the Schuylkill River watershed are administered through numerous private, public, local, state, and federal organizations, many of whom make funding decisions about the Schuylkill watershed independently of each other. With no formal mechanism for coordination, funders have no means of preventing duplicate or opposing projects. If two applicants with high quality, yet similar overlapping proposals each apply to different funding sources, the funders are unable to systematically identify the overlaps, and therefore are unable to take appropriate action to foster partnerships and coordination of tasks. In addition, while funders typically encourage applicants to match monies to other sources, funders themselves have no system through which to identify common goals or to work together to leverage their monies with other organizations in order to achieve these goals.

Through the protection and restoration fund, the SAN seeks to improve communication and coordination particularly among local funders. Specifically, the fund will consist primarily of regular contributions from local governments, water suppliers, private corporations, foundations, and municipalities and may be supplemented by government fine monies. Contributors to the fund will oversee fund dispersal and will make concurrent and coordinated decisions about funding based in part on priorities identified by the SAN. This coordination will help decrease duplication, base decision-making upon common goals, and allow for improved leveraging of local monies. When leveraged with dollars from state and national sources, the fund will lead to a sustainable supply of monies for project implementation in the Schuylkill River watershed over many years. The fund is in the early stages of development. A final business plan is scheduled to be complete by summer 2005, and the SAN will begin seeking contributions to the fund at this time.

The SAN is also developing a "project bank" that will ultimately become part of the protection and restoration fund. This idea stems from input received during a funders meeting hosted by the William Penn Foundation, where SAN members learned that many of the larger funders in the region are interested in seeing a list of priority projects for the watershed. In addition, private corporations have approached the SAN, because they are interested in implementing restoration projects as part of a "trading" program to meet wetland mitigation requirements. The project bank is also intended to be used by polluters that are required to construct environmental restoration projects and implement educational programs as part of their settlement agreements with EPA through the Supplemental Environmental Projects (SEP) policy. The projects will be identified and prioritized by members of the SAN workgroups. The list will be reviewed periodically and updated by the SAN Planning Committee to ensure that the projects remain current.

4.2 Public Outreach

4.2.1 Philadelphia Water Department Programs

A strong public outreach program is instrumental in the successful implementation of this protection plan. In order to effectively address public outreach and participation, PWD has included a four part approach to engaging the public during plan implementation:

1) PWD's Water Quality Committee and Citizen's Advisory Council
2) Schuylkill Action Network Education/Outreach Workgroup, SAN website; media events
3) Collaboration with PDE in executing source water protection educational initiatives
4) Fairmount Water Works Interpretive Center

The goals of the public participation approach are to engage and educate the public about potential threats to the Schuylkill River, to educate the public on the activities planned by the SAN to address those threats, and instill behavioral changes in the public in how they view the Schuylkill River as a drinking water and recreational resource.

PWD Water Quality Committee (Internal)

The PWD Water Quality Committee is an internal committee that has representatives from a variety of PWD divisions and units, including: Water Treatment, Distribution, Bureau of Laboratory Services, Wastewater Treatment, Collector Systems, Planning and Research, Office of Watersheds, and Public Affairs. The committee was formed in 1995 with the mission to ensure better communications regarding potential water quality and customer communication. The committee has tackled many projects over the years, the largest one being the development of a "Microbial Action Plan" and was instrumental in the creation of the department's Safe Drinking Water Act mandated Consumer Confidence Report. The Water Quality Committee works in partnership with PWD's Citizens Advisory Committee to develop customer information that is consumer friendly and relevant. The committee is currently chaired by Ed Grusheski, Public Affairs Manager, and meets on a monthly basis. The Water Quality Committee has been involved with the development of this protection plan, and highlights of the plan were presented at a meeting held in November 2004.

PWD Citizens Advisory Committee (External)

PWD's Citizens Advisory Committee (CAC) consists of representatives from environmental and community organizations, and public agencies, as well as concerned citizens and business owners. The general public is notified of the meeting place and time via local newspapers and new members are always encouraged to attend. Specific agencies represented include PADEP and the Philadelphia Department of Public Health. Public participation will continue throughout the implementation of the protection plan. Meetings are held quarterly at the offices of the Philadelphia Water Department. The final version of this protection plan was presented to the CAC in spring 2005.

The CAC was formed by PWD as part of a commitment by the agency to develop a public education and participation program to focus attention on stormwater runoff pollution prevention. The purpose of the CAC is twofold:

1) to encourage changes in individual behavior that will improve surface-water quality

2) to develop an informed citizenry that will support City-proposed water quality improvement programs needed to comply with state and federal regulations

The CAC's target audiences include:

- Businesses contributing to stormwater pollution, such as building contractors, landscapers, and automobile repair shops;

- Government agencies and non-profit groups interested in clean water, such as watershed and environmental groups, estuary programs, and environmental organizations;

- Institutions well positioned to deliver behavior-changing messages to their constituencies and the general public, such as the Philadelphia Zoo, the Franklin Institute, the Academy of Natural Sciences, and the Schuylkill Center for Environmental Education;

- The transportation sector, including SEPTA, PENNDOT, and organizations involving motor vehicle owner interests; and

- School District of Philadelphia, universities, colleges, and other academic institutions.

The CAC implements its goals by targeting its programs to specific audiences. Examples of these programs include the following educational initiatives:

- **Earth Day 2005 Storm Drain Marking Project** – For the sixth year, a city-wide storm drain marking program was held. The 2005 program will continue identifying volunteers who are willing to adopt storm drains, which they, with support from PWD, will maintain on an ongoing basis.

- **6th Annual "Clean Water Begins & Ends with You" Drawing Contest** – We will coordinate a drawing contest for all Philadelphia students in grades K-12. The winning drawings will be published in a calendar and will be printed on car-card advertisements that will be posted on SEPTA buses and subway cars during the month of April 2005. The winning students will be recognized at an awards ceremony.

- **Expansion of the Manayunk Dog Waste Collection Pilot Program** – In May 2001, a pilot program was implemented, in Manayunk, to help reduce the amount of dog waste that ends up in the Schuylkill River. Dog-waste collection bag distribution and collection units (dog toilet systems) were placed in several locations where residents are known to walk their dogs. The utilization of these units is being monitored to assess their effectiveness. This information will be used as we expand the pilot project in FY '05 to other neighborhoods across the City.

- **Promotion of Water Quality Report** – During FY '05 we will work with the CAC and PWD staff to develop promotional activities for the Water Quality Report that the Philadelphia Water Department Publishes on an annual basis.

- **Water Education Resource Guide** – The fourth edition of the Water Education Resource Guide will be printed and distributed. This guide, which currently includes 102 organizations that offer water-related education information and programs, will be updated and expanded.

- **2005 Philadelphia Flower Show** – The CAC worked with PWD to develop the theme for an exhibit at the 2005 Philadelphia Flower Show.

- **Coast Day 2004 and 2005** – PWD and the CAC took a leadership role in planning the second and third annual Pennsylvania Coast Day Celebration, which took place in the fall of 2004 and 2005. The site of the celebrations was the Fairmount Water Works.

PWD's Watershed Information Center (Internal/External)

In early 2005, PWD developed a conceptual plan for a web-based "Watershed Information Center." The Center is a regional resource of Southeastern Pennsylvania watershed-related information that centrally locates technical, management, and administrative tools and capabilities to support those involved in watershed planning. The Watershed Information Center is located at www.PhillyRiverInfo.org and www.SoutheastPARiverInfo.org. Information on the site is organized by watershed and by the Philadelphia Water Department program that generated the information. PWD is still developing and adding content to the website. The Department is also refining the homepage to include more content and interactive capabilities.

4.2.2 SAN-Schuylkill Action Network (External)

While PWD's Water Quality Committee and CAC focus mostly on the residents and businesses within the City of Philadelphia, the work of the SAN extends beyond the City and throughout the entire Schuylkill River watershed. Two specific features of the SAN make it integral to engendering public participation throughout the watershed to help implement the source water protection. These features include activities of the SAN's Education/Outreach Workgroup and the SAN website.

Education Team Summary

The primary purpose of SAN's Education/Outreach team is to promote awareness among the general public that the Schuylkill River is a drinking water source, that land-based activities running the entire length of the river have degraded water quality, and that individuals can modify their behavior to improve the quality of the water they drink. The workgroup also aims to educate the public, both within and outside the watershed, of the SAN's goals to improve the quality of the Schuylkill River through implementing restoration projects, sharing data and information among stakeholders, and promoting education on a watershed scale. These efforts aim at recruiting new membership to the SAN and advancing the SAN as a model for other watersheds. The Education/Outreach Workgroup also works to educate specific populations, including water suppliers, municipal officials, property managers, developers, and landscape architects, of low impact development techniques and retrofitting of stormwater controls that can reduce stormwater runoff, thus reducing its harmful effects on the river. In all, the

Education Workgroup seeks to instill the word "Schuylkill", as it refers to the river and not the parallel-running highway, as a "household" name.

Education Team Successes

In cooperation with other SAN Workgroups and stakeholders, the Education and Outreach team organized a media event during Drinking Water Week of 2004 to formally introduce the SAN to the public and to publicly recognize schools in the watershed that have implemented land management techniques on their campuses to reduce or treat stormwater runoff. With over 100 people in attendance, the SAN's lead agencies signed the Constitution of the Schuylkill Action Network, demonstrating their commitment to their responsibilities (see Figure 4.2.2-1). Members of the public also signed the Constitution to show their support of and commitment to the SAN's efforts and to convey the importance of each person's role in protecting and restoring the Schuylkill as a drinking water source. Footage from the event was aired on at least one major network affiliate during prime news hours.

Figure 4.2.2-1 Constitution of the Schuylkill Action Network

Constitution

of the Schuylkill Action Network

WE, the people of the Schuylkill River Watershed, in gratitude for the land, water and beauty that this watershed has bestowed upon our lives, and in recognition of our mission to improve and protect this precious resource, do hereby proclaim to work together to ensure the bountiful future of this watershed. We hereby ordain and establish this document to be called the Constitution of the Schuylkill Action Network as our pledge to this worthy effort.

ARTICLE I. Who is the Schuylkill Action Network (SAN)?

The fundamental nature of this Constitution is the outcome of the SAN, an unprecedented partnership including representatives of United States Environmental Protection Agency, Region III, Pennsylvania Department of Environmental Protection, the City of Philadelphia Water Department, Delaware River Basin Commission and Conservation Districts, local officials, watershed organizations, and concerned citizens.

ARTICLE II. What is the Schuylkill Action Network (SAN)?

The purpose of SAN is to bring people together to restore and protect the drinking water and water quality of the Schuylkill River, which provides water for drinking, thermoelectric generation, fishing, and recreation in eastern Pennsylvania.

The SAN will work towards restoring and protecting the Schuylkill River watershed as a regional drinking water source; promote stewardship and education; transfer the experience and lessons learned to communities; and enhance intergovernmental communication and coordination.

ARTICLE III. Why is the Schuylkill Action Network (SAN) important?

The people of the Schuylkill River watershed, including generations yet to come, have a right to safe drinking water, a river that is a recreational and economic resource and a watershed that sustains healthy habitats for all life in this region.

Therefore, we, the leaders of the SAN, support this Constitution with a firm belief that partnerships will allow us to restore and protect our watershed, pledge to each other our commitment to SAN and invite all members and Schuylkill River watershed participants to join us in signing this Constitution.

United States Environmental Protection Agency, Region III

Pennsylvania Department of Environmental Protection

City of Philadelphia

Delaware River Basin Commission

Upcoming Activities

The Education/Outreach team is implementing additional plans to extend both within and outside the watershed and engage support and participation from the public. Beginning in September 2004, the SAN will participate in the following activities:

- Annual Southeastern Pennsylvania Coast Day
- Presentation at Water Resources Education Network, sponsored by the League of Women Voters of Pennsylvania, the Urban Summit, and the Pennsylvania Watersheds Conference
- Develop a public display for events focusing on AMD, stormwater, agricultural impacts, and wastewater discharger compliance issues
- Attend regional and state meetings of regional officials
- Develop articles for publication

The SAN Education/Outreach Workgroup will also be implementing the projects listed in Table 3.4 of this protection plan. Detailed information on these projects is located in Sections 3.2 and 3.3. Members of the SAN Education/Outreach Workgroup are kept informed of the activities of PWD's Water Quality Committee and Citizen's Advisory Committee through PWD representatives on the SAN Workgroup. This open communication between groups allows them to build upon existing programs without duplicating efforts.

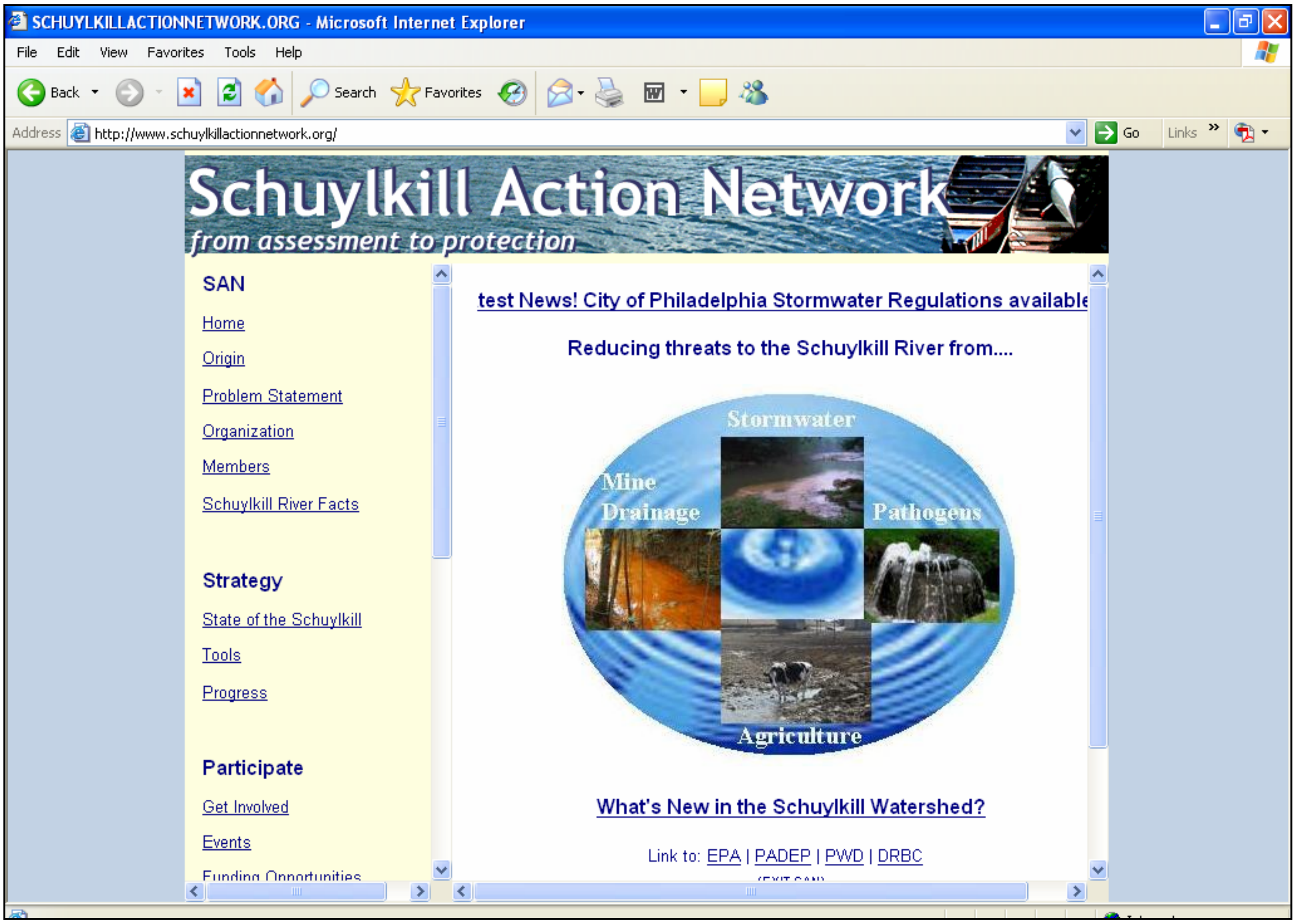
This protection plan was developed as the SAN identified its own priorities and goals. The plan includes input from the various SAN workgroups, and information from the plan has been provided to the SAN as it was developed to assist the workgroups in determining priority protection and restoration areas. The SAN Planning Committee also coordinated the final review of this protection plan.

4.2.3 SAN Website

A website was developed by the SAN (www.schuylkillactionnetwork.org) to provide a location where information about the organization and the Schuylkill River watershed can be easily accessed by SAN members and the public (see Figure 4.2.3-1). A website was considered the best way of providing workgroup meeting information, meeting minutes, restoration project information, and upcoming events. The information placed on the website is geared to all internet users, including residents, businesses, government officials, etc., within and outside the Schuylkill watershed, with an interest in the Schuylkill River as a drinking water source and/or to those that want more information about the SAN's watershed based approach to restoring and protecting the river.

The SAN website focuses on the organization's background, purpose, structure, and members as well as general facts about the Schuylkill River watershed as they relate to geography and history, impacts to the river from land-based activities, and completed studies that are related to the goals of the SAN. Links are provided from the SAN's homepage to the SAN membership form, the Schuylkill River events calendar, and to other websites with information on funding opportunities.

Figure 4.2.3-1 Picture of the SAN Website Homepage (www.schuylkillactionnetwork.org)



4.2.4 Partnership for the Delaware Estuary Workshops

The Partnership for the Delaware Estuary, Inc., (PDE) is a non-profit organization that was established in 1996 to participate in the implementation, continued development, and updating of the *Delaware Estuary's Comprehensive Conservation and Management Plan* (CCMP). PDE works to protect the environment, promote conservation of the natural resources, and contribute to the usefulness of the Delaware Estuary and its tributaries for recreational and commercial purposes that are compatible with the sustainable use of estuarine resources. The Partnership also works with PWD to promote the importance of source water protection by targeting communities, both within and upstream of Philadelphia with educational programming and watershed stakeholder training.

Three primary programs include the following:

- **Clean Water Partners –** Clean Water Partners (CWP) is a program that educates small to medium-sized businesses about the types of best management practices that can be implemented on their sites to reduce non-point source pollution. CWP is a voluntary, non-regulatory program. With funding from Growing Greener, the Partnership piloted CWP in West Whiteland Township in Chester County and in the Roxborough and Chinatown neighborhoods in the City of Philadelphia involving more than 30 businesses. The program is currently being expanded to include municipalities throughout the Schuylkill River watershed.

- **Sense of Place** - Sense of Place demonstrates the value of conservation partnerships between nonprofits, municipalities, and schools. The project has provided a model for a watershed approach to land management by controlling invasive plants, reducing pesticide and fertilizer use, and improving wildlife habitat, thereby reducing the negative impacts of stormwater runoff on our waterways.

- **Corporate Environmental Stewardship** - The Corporate Environmental Stewardship program provides corporations and industry with the technical expertise necessary to properly manage and enhance their company's property. This program has assisted corporations in restoring wetlands, protecting fish and wildlife habitat, preserving open space, and protecting water quality.

4.2.5 Fairmount Water Works Interpretive Center

The Fairmount Water Works Interpretive Center, a program under the Philadelphia Water Department, opened in fall 2003. The 9,000 square feet facility is located at river level on the Schuylkill and highlights education exhibits under the topic, "Water is Our World." Through the various exhibits, visitors learn the about their role in reducing non-point source pollution and achieving the goal of fishable and swimmable water quality. The mission of the center is to:

- Educate citizens to understand their community and its environment,
- Know how to guide its future, and
- Understand the interconnections between their daily life, ecology, and the natural environment.

The SAN Drinking Water Week Event of 2004 was held at the Fairmount Water Works Interpretive Center and included the announcement and signing of the "Constitution of the Schuylkill Action Network. " Future SAN related events are expected to be held at the Center, and the Education/Outreach Workgroup will work with representatives of the Fairmount Water Works Interpretive Center on developing new exhibits.

Section 5. Source Water Early Warning System & Contingency Planning

5.1 Delaware Valley Early Warning System

5.1.1 Introduction to the Delaware Valley Early Warning System

A key recommendation of the Source Water Assessments for the Schuylkill River intakes was to develop a watershed-wide Early Warning Monitoring Network to provide early detection and notification of discharges to or changes in the quality of the surface water supply. PWD pursued this recommendation, and in 2002 and 2003, developed the Delaware Valley Early Warning System (EWS).

The Delaware Valley EWS, which covers both the Schuylkill and lower Delaware Rivers, is a fully integrated computer-based system that includes three major components: a telephone-based notification system, the Delaware Valley EWS website and data management system, and a water quality monitoring network. The system provides a secure and centralized location through which the EWS participants, including water utility personnel, emergency responders, government agencies and industry representatives, can share information about source water quality and emergency or contamination events.

The telephone notification system is a powerful tool that allows a caller to initiate emergency notifications to multiple recipients through a single call. The system accepts calls from emergency responders or water utility personnel, records event information provided via touch-tone responses to a standard question and answer process, and makes telephone and email notifications to affected EWS participants. This automated process reduces the burden on the emergency responders and other information providers by providing multiple and redundant calls to system participants, and also reduces the possibility that a notification could get lost or mis-routed.

The EWS website provides a dynamic and interactive user interface to the EWS database, allowing users to access and share event and water quality information via the internet. Various user interface formats are available, including forms for reporting and viewing the details of a water quality event, maps to identify the location of an event, graphs that present water quality, and a time of travel estimator. The time of travel estimator uses real-time flow data from USGS gauging stations to provide plug-flow travel time estimates for each downstream intake based on current river conditions. These tools allow PWD and the other water purveyors within the Schuylkill and Delaware River watersheds to be more informed about water quality throughout watershed and thereby be better prepared to react to changing or emergency conditions.

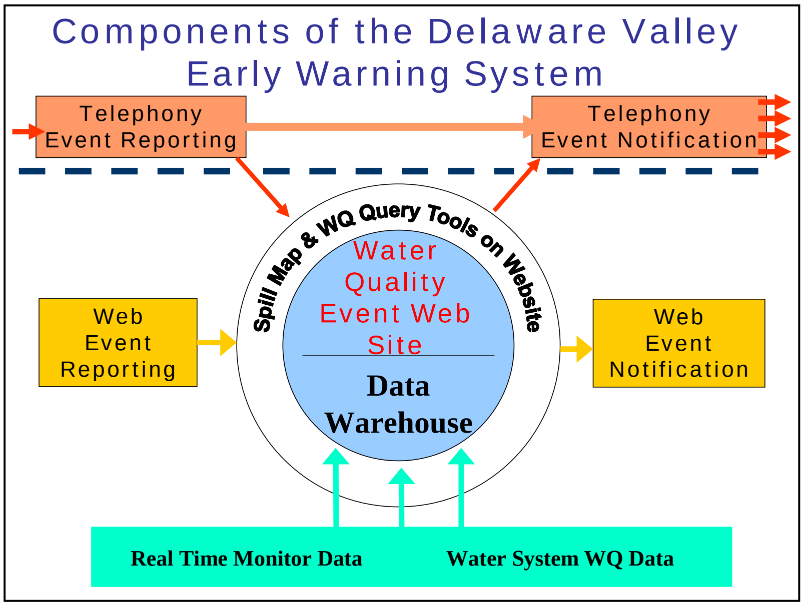
The water quality monitoring network compiles both near real-time and historic water quality data. The near real-time network utilizes continuous water quality monitors that are located at select water treatment plant intakes and USGS gauging stations and transmits data collected at those locations to the EWS server, thus making accessible via the website. The water quality monitoring network provides water suppliers with near real-time information about water quality upstream of their intakes so that they can anticipate changes in water quality and adjust their treatment accordingly. Real-time monitoring is currently limited to simple water quality parameters such as turbidity and pH, but the network will be expanded in future years as monitoring technologies advance and as other monitoring needs are identified. In addition to the near real-time data, utilities will submit the results of their routine operational monitoring, creating a historical database against which real-time data can be compared. The system has the potential to incorporate sophisticated monitoring equipment like gas chromatographs and bio-monitors that can detect changes in water quality that might result from major discharges or intentional contamination.

One of the unique features of the Delaware Valley EWS is that the system operates essentially unmanned. Once an event is reported via telephone or the Internet, the system will automatically perform the time-of-travel estimations, and notify downstream users. The system users will then perpetuate the development of the event by using the website to gather and report updates and additional information.

5.1.2 EWS Protocol

The EWS can be used to fulfill several different source water protection needs. First and foremost, it is a communication and notification system that emergency response personnel and water suppliers can use to share information about source water contamination events. Second, it provides access to water quality data throughout the watershed thus alerting water suppliers to a change in water quality long before it reaches their intake. In the future, dischargers will be encouraged (preferably required) to use the EWS to make downstream notifications of overflows, spills and accidental discharges. Each of these functions is illustrated in Figure 5.1.2-1 and described in detail below.

Figure 5.1.2-1 Components of the Early Warning System



Emergency response personnel and water suppliers often observe a water quality event or are notified by the public. A water quality event can be anything from a transportation accident, to a fire, to a sewerage overflow, to illegal dumping, which results in a discharge to the river or sewer system. Upon being made aware of and confirming an event the responding party can use the EWS to notify downstream users by calling the EWS telephone notification system or by reporting the event to the EWS website (www.DelawareValleyEWS.org). In reporting the event, the responding party will supply information about the time, location, risk level, cause, and result of the event. The EWS uses the location information to identify the appropriate parties to notify. The system currently determines whether the event occurred in the Schuylkill or Delaware watershed and notifies all participating water suppliers, emergency response personnel and agencies within that watershed. In the near-future, the system will use location information to identify and notify only those participants downstream of the event. Notifications are made by phone for high risk events or by email for lower risk events (additional flexibility for notifications is a future goal of the system). If a telephone notification is delivered, the notification consists of a standard message that informs the recipient that a water quality event has occurred followed by specific information about time and location of the event and, if available, a message from the reporting party. If an email notification is sent, the email message contains critical information including the time, location and description of the event, and advises the recipient to go to the web-site for additional information. The recipient of the notification will then either call the telephone system or log onto the website to receive more information. The web-site will have an event report with all of the information that the responding party provided. The web-site also has a time-of-travel estimator that uses real-time USGS flow data to estimate the time at which the contaminant will arrive at the downstream intakes. Downstream water suppliers can also access water quality data associated with the event. The water suppliers can use the time-of-travel and water quality information to plan their response strategies. As the event progresses, the information provided on the web-site can be updated by the initiator of the report or by other participants as they learn more about the event. In this way, the water supply community can communicate and be kept abreast of the event as it unfolds. All of this occurs in a secure environment.

The EWS water quality monitoring network collects continuous water quality data from select drinking water intakes along the mainstem Schuylkill River and transmits that information to the EWS server, thus making it available to the EWS participants via the EWS web-site. Currently, there are four water quality monitoring stations in the Schuylkill watershed EWS monitoring network. Water suppliers can log on to the EWS web-site on a daily basis to see water quality information from these locations, which span from Wadesville to Philadelphia. This type of analysis will allow water suppliers to identify changes in water quality associated with both natural and accidental contamination events. For example, storm events and algae events are two naturally occurring events that will impact the water treatment process. Fortunately, both are easily identifiable using simple on-line monitors like turbidity and pH. A downstream utility can track changes in these parameters and know when they need to initiate a treatment process change in order to effectively treat the water. Similarly, significant accidental spills to the river may be detected in through changes in pH or conductivity. The EWS water quality monitoring network will allow water suppliers to be more proactive, rather than reactive when it comes to responding to changes in water quality.

PWD worked closely with PADEP's Emergency Response team in the development of the EWS. During this process both PWD and PADEP ER agreed that one of our mutual goals is to have dischargers add the EWS to their downstream notification list. In this way we could insure that downstream water suppliers receive information about overflows, spills and accidental discharges. PWD is in the process of working with PADEP to make this happen. This will likely necessitate DEP incorporating the EWS into the dischargers' permit requirements. If such a requirement is implemented, the discharger would call the EWS telephone system or enter the event into the EWS web-site to initiate downstream notifications. Having dischargers contact the EWS directly will increase the number and geographic diversity of downstream notifications with just a single phone call.

The Delaware Valley EWS has tremendous potential to protect help water suppliers become aware of and react to water quality events of all kinds. The system is a tool to help water suppliers respond to the accidental, terrorist and natural water quality events that cannot be prevented by standard source water protection measures. In this way, the EWS is a perfect complement to a well developed source water protection program.

5.2 Contingency Planning

The Philadelphia Water Department is dedicated to providing a continuous supply of high quality drinking water to our costumers and has gone to great lengths to prepare for situations that might affect our ability to accomplish this goal. One such effort was the development of the PWD Emergency Response Plan (ERP), completed in September 2003. The ERP is a comprehensive document that compiles individual plans addressing operating and communication procedures to be followed in the event of emergency situations resulting from source water contamination, distribution system contamination, microbial contamination, a disturbance resulting from Limerick Generating Station, or a disturbance resulting from a spill at one of PWD's three drinking water treatment plants. The ERP contains a contains a Contaminant Response Plan, which is dedicated to responding to source water contamination emergencies including events resulting from a failure at Limerick Nuclear Generating Station. The general section of the Contaminant Response Plan is most relevant to this source water protection plan and is included below.

Any PWD staff that becomes aware of contamination or potential contamination of the source water should follow the procedures outlined in this plan. During the regular working day, PWD management, the affected plant manager and the police department should be notified immediately. During off hours, the stand-by water treatment engineer can be reached by contacting the City Hall Operator. A telephone contact list is included below.

	OFFICE #	CELL OR PAGER #
Philadelphia Police Department	911	
24 Hour Hotline - City Hall Operator	(215) 686-4514/4515	
PWD Management		
Water Commissioner Bernard Brunwasser	(215) 685-6106	C - (215) 847-2995
Deputy Water Commissioner Debra McCarty	(215) 685-6102	C - (267) 278-8603
Deputy Director of Operations Bruce Aptowicz	(215) 685-6205	C - (215) 828-0687
Water Treatment Plants Manager William Wankoff	(215) 685-6257	C - (267) 278-8601
Water Treatment Plant Managers		
Baxter WTP Manager - Kate Guest	(215) 685-8020	C - (215) 906-0150
Baxter WTP Process Control Room - 24 hour #	(215) 685-8055	
Belmont WTP Manager - John Muldowney	(215) 685-0200	C - (215) 906-0151
Belmont WTP Process Control Room - 24 hour #	(215) 685-0227	
Queen Lane WTP Manager - Jerry Kuziw	(215) 685-2101	C - (215) 906-1147
Queen Lane WTP Process Control Room - 24 hour #	(215) 685-2117	

5.2.1 Contaminant Response Plans for Accidental or Deliberate Release into Source or Potable Waters

INTRODUCTION

Effective response to the threat of contamination to potable water from chemical, biological or radiological agents is a major concern to the Philadelphia Water Department. The guidelines and actions presented in this plan incorporate these concerns into an action plan for water pollution events. The objective of this document is to provide a comprehensive response plan for water plant operators and managers.

DEFINITION of a POLLUTION EVENT AFFECTING DRINKING WATER:

1. Accidental, Non-significant Pollution Event: water contamination affecting PWD's drinking source water or process water which results from an accidental release of any material which has no measurable impact upon finished water quality i.e. incidental contamination of source water resulting from a boating or vehicle traffic accident. After a determination is made, the response involves routine plant notification and control laboratory monitoring.

2. Accidental, Significant Pollution Event: water contamination affecting PWD's drinking source water or process water which results from an accidental release of any material which has a likely and detectable impact upon finished water quality. A treatment process response to mitigate any water quality impact is expected. These may include the application of powdered activated carbon, the chlorination of the RWB intake or the shutdown of a plant's intake to allow for the passage of the contaminant. Examples of this type of incident include the release of significant quantities of a contaminant resulting from a tank truck traffic accident or the runoff from an industrial fire. After a determination is made, a response requires routine plant notification and control laboratory monitoring of process and source waters. An appropriate response also requires water treatment mitigation, immediate notification to the affected facility and communication to PWD management. The Industrial Water Unit (IWU) should be notified of the source water contamination incident. IWU is expected to conduct a source water investigation and to assure that the proper steps are taken to halt any continuing pollution and to reduce the levels of released contaminants.

3. Deliberate Contamination Event: water contamination affecting PWD's drinking source water or process water which results from a deliberate act to contaminate the drinking water supply or to disrupt the water treatment process. This determination will be complex and difficult since the judgment refers to the intent of the polluter. As an example, this category does not include the deliberate release of several quarts of motor oil into a storm sewer inlet. However, the discharge of a much larger amount of oil into a storm sewer, in the vicinity of a water intake structure or into a water plant basin or tank would be considered a deliberate act. Clearly, any contaminant introduced into a treatment plant where the source is neither from natural nor can be explained as an accidental in-plant spill should be considered a deliberate event. The intent of the polluter who introduces a contaminant into the source water is more difficult to determine. Heretofore, all source water contamination events have been considered accidents. For a contamination event to be considered deliberate it must contain certain elements; the type, amount or concentration of the contaminants likely to affect finished water

quality and the absence of any reasonable physical evidence to explain the source and location of the contaminant other than a deliberate act. Credible reports (see definition later in this document) of an individual observed to release materials around a water intake would be included as a deliberate act. General and specific water treatment process options for credible threats are also presented in this document. Until proven otherwise, the initial assumption should be that the impact of the contaminant release is significant. An appropriate response requires water treatment plant mitigation, including; the immediate notification of the affected facility, the immediate interruption of routine plant operations until the incident is assessed, an investigation by IWU, communication to PWD management, the Philadelphia Police Department and PADEP. Source water and process monitoring must be initiated, immediately.

INFORMATIONAL SOURCE of CONTAMINATION or a FUTURE THREAT

(code: HC-high credibility, UC-unassigned credibility)

code:	
HC	Visual evidence of a substance release (i.e. containers observed in water, other sensory determination- sheen, particles, color, odor)
HC	Confirmation of river contamination communicated from an upstream utility
HC	Information from Philadelphia Health Department of a waterborne illness in the community
HC	Visual observation by a reliable source (i.e. PWD employee, Police) of a substance being released
HC	Analytical detection of contamination by a WT Plant or BLS laboratory
UC	Report, by a questionable source (i.e. anonymous phone call), of a visual observation of a substance release
UC	Referral to PWD via phone from city, state or federal agencies of threat of contamination
UC	General information from Police, FBI or other similar agencies of a future threat

INVESTIGATIVE and COMMUNICATION ACTIONS

code: 1. Perform for all sources
2. Perform whenever contaminant has, or will, affect the public
3. Perform at the direction of PWD management

code:	
1	Contact the Police Department (911)
1	Inform PWD management; WTPs Manager, Operations Manager, Deputy Commissioner and Water Commissioner
1	Contact affected plant and their management
1	As applicable, investigate scene for evidence of forced entry or substance release (as appropriate, use IWU for investigative and sampling services)
1	As applicable, collect appropriate samples and contact BLS for analyses
1	Inform Load Control Center
2	Inform PaDEP
2	Inform Philadelphia Health Dept.

2 Inform Public Affairs Division
2 Inform members of Water Quality Committee (may be accomplished via email during normal business hours)
2 Inform applicable wholesale customers
3 Inform USEPA – Region 3

GENERAL TREATMENT OPTIONS for HIGHLY CREDIBLE THREATS

The strategy includes:

- Raw Water Pumping Station shutdown (at the appropriate time given location of the contaminant and time of travel issues)
- Plant shutdown (at the appropriate time given location of the contaminant and time of travel issues)
- Isolation of contaminated plant elements (use of bypass capabilities to restore facility operation)
- Identification and quantification of contamination
- Mitigation of contamination via treatment or discharge of water to waste.

The following treatment options should be followed, at the appropriate time, for all threats of high credibility (HC):

- Application of powdered activated carbon to the rapid mix (a dosage of 100 #/MG)
- For instances when contamination is believed to have affected either the river or the raw water basin, application of raw water basin influent chlorine to meet plant effluent residual requirements
- For instances when the contamination is believed to have affected processes downstream of the rapid mix, application of chlorine to the rapid mix to meet plant effluent residual requirements.
- Shut down of ammonia (only with the approval of PWD management)

SPECIFIC TREATMENT OPTIONS for CREDIBLE THREATS

Baxter:

If contaminant in RWB, cease pumping and open RWB by-pass gates.
If contaminant in river, skip tidal fill cycle.
Shutdown of RWB may require minimum treatment rates to maintain water over filters.
F/S basins and filters drain to RWB. Isolate RWB prior to draining those basins.

Queen Lane:
Isolation of RWB by use of bypass
Draining of F/S and filters are OK to sewer

Belmont:
Isolation of RWB by use of bypass
If contamination of RWB is limited to one basin, isolate.

Draining of F/S and filters are OK to sewer

INITIAL RESPONSIBILITIES:

1. Water Treatment Standby is responsible for any immediate decision to shut intakes. Decisions must be made in conjunction with the Load Control Standby engineer upon verification that there is a known contamination problem at the intakes. PWD Operations Management must be notified if there is a decision to close an intake.

2. If information is such that no immediate impact to any intake can be definitively derived, then that decision should be deferred until more information can be determined.

3. Immediate contact should be made to Industrial Waste Unit (IWU) Standby. If intake(s) are believed vulnerable then IWU Standby must proceed immediately to intake to assess situation. IWU will proceed to spill or contaminant source to gather additional information. If intakes are not in immediate peril, then IWU may proceed alone to verify spill and gather all pertinent information.

4. Contact should be made with WT plant control lab(s) to give them all information known. If necessary, increased odors or finished water taste and odor tests should be conducted, with instructions to notify Standby engineer of any unusual taste and odors detected. Control labs should be advised of expected odors or tastes from spill type.

5. Whether by Industrial Waste or Standby engineer, samples of river water containing spill should be brought to control lab to assess problem and familiarize chemists with spill odors, if applicable. Samples should be taken in glass jars so as not to interfere with odor.

6. When spill has been verified, immediate attempts to contact plant manager(s) or plant engineer(s) should be taken. Standby engineer remains in charge of plant control lab(s) until relieved by affected plant(s) management. In case of major spill in off-hours, when only one member of plant management might be reached, Standby engineer should be available to assist plant(s) in sample taking or other tasks as directed by the plant(s) management.

7. Until relieved by affected plant(s) management, Standby engineer is responsible for all decisions and contact with support group such as IWU, BLS, and Load Control. This includes immediate consultation with Load Control Management (See Load Control Emergency Notification Procedures) if the intake(s) are ordered or expected to be ordered closed, and decisions on sampling, such as types, locations, and number of samples, as well as coordination with BLS (See BLS Emergency Notification Procedures) if analytical support is necessary. Water Treatment, whether it's the Standby engineer or the affected plant(s) management, is ultimately in charge and responsible for the spill response to protect water quality. Therefore, it is recommended that the response be measured and limited to that which can be practically controlled at all times so as not to increase confusion. The goal is to minimize activities which can have a deleterious effect on the response.

RESPONSE PLANT CHECKLIST FOR SPILLS/CONTAMINANTS

The following is a checklist that should be used as a guide by WT's Standby Engineer when gathering information concerning a potential spill or contaminant at an intake:

I. INFORMATION TO OBTAIN, IF POSSIBLE, AT TIME OF NOTIFICATION:

1. Name of person reporting contamination
2. Date and time of notification
3. Date and time of spill
4. Identify contaminant
5. Location of contaminant and time it was observed
6. Identify source of contaminant
7. Identify quantity of contaminant and flow information (is the release a one time limited discharge or a continuous flow?)
8. Identify responsible party for contamination and contact information
9. Identify responsible party for containing and/or clean up of spill
10. Identify authorities (including PWD employees) on site or in-route to spill and contact information such as cellular phone #'s or pager #'s.
11. Identify raw water intakes affected
12. Determine estimated duration of spill affecting intake
13. Contact Water System Transport Operator (LdC operator if not being notified, by such) and give all known information from above, and where you will be and how they can contact you. Remember, from now on, Load Control will be the communications center for this episode and they must always know where you are and how to reach you.

II. INFORMATION TO OBTAIN IMMEDIATELY FROM AFFECTED PLANTS:

1. IDENTIFY IMPACT ON WATER TREATMENT CAPACITY:

   a. Determine raw and finished water basin elevations
   b. Current treatment rate
   c. Ability of plant to avoid treating spill by using available storage to allow spill to pass by intake – joint WT/LdC decision

2. IDENTIFY TREATMENT FEASIBILITY:

   a. Determine ability of conventional treatment and/or powdered activated carbon to handle contaminant. (Jar tests using sample water from the spill provided by the stand-by engineer may be necessary for this).
   b. Determine available carbon storage, if applicable, and feed rate capabilities and compare with estimated spill duration.

III. COORDINATED STRATEGY:

1. With all the information assembled, develop with Load Control, a strategy for this event that insures a safe potable water supply while balancing the needs of the entire water system and economy.

DIRECTIONS FOR CONTACTING LOAD CONTROL

I. OPERATIONAL RESPONSIBILITIES:

A. Load Control regulates the water supply system, including raw water supply rates.

B. Water Treatment regulates the treatment process, including determining feasibility of treatment of raw water.

C. Load Control's standby engineer and water treatment's standby engineer jointly decide response strategy to any potential contaminant spill that imperils water quality, including the decision to close the intake or treat the affected waters. The Load Control standby engineer directs the Load Control operator and the Treatment standby engineer will direct the activities of the plant(s) operators and chemical technicians.

II. COMMUNICATIONS:

A. All watershed contamination events are to be called into the Load Control operator, the Water Transport System Operator (WTSO).

B. The Load Control operator will notify water treatment's standby engineer, the Industrial Waste Unit's standby technician, and the Load Control standby engineer.

C. The WTSO will act as the communications center for the entire response and therefore must be kept continually up-to-date and must be able to contact all involved parties at all times. Communications during these events are crucial.

D. The Water Transport System Operator may be contacted by:

Primary phone number:	215-685-9609
Secondary phone number	215-685-9636

INSTRUCTIONS FOR CONTACTING THE INDUSTRIAL WASTE UNIT

I. RESPONSIBILITIES:

The Industrial Waste Unit investigates spills that may impact the Water Treatment Plants. The IWU responder's primary responsibility is to use their knowledge and experience to insure that the spill is properly contained and/or cleaned-up so as not to affect raw water quality. This may include attempting to identify a source when one is not known or using their resources to contain the spill if the responsible party can not be identified or is unable to adequately respond.

II. COMMUNICATIONS:

Industrial Waste Unit maintains a technician on standby who is contacted on all reported spills. The Load Control operator should have the schedule and be able to contact IWU's standby person and to provide Water Treatment with his/her name, cellular phone and pager number. The Load Control operator is usually kept up-to-date on this list. However, just in case, a current listing of the Industrial Waste's Personnel and numbers is provided below. Please use the 215 area code before the number.

NAME	BEEPER #	HOME #	OFFICE #
Thomas Healey, Chief	507-0289	632-9908	685-6233
Evan Schofield	507-0304	677-7819	685-8068
Joseph Morrow	507-0361	365-4896	685-8034
Robert Gonsiewski	507-0302	934-7932	685-8093
Joseph Cerrone	507-0386	969-5380	685-8030

DIRECTIONS FOR CONTACTING BUREAU of LABORATORY SERVICES

I. RESPONSIBILITIES:

The Bureau of Laboratory Services (BLS) has no formal responsibilities relating to a contaminant spill event except for their continual role to provide the necessary laboratory and analytical support to the affected operational units; Water Treatment and Industrial Waste. BLS may also be able to provide some field services, as requested. The labs can provide 24 hour analytical support, either in-house or on contract.

II. COMMUNICATIONS:

Since BLS does not have a standby program, in order to contact a responsible laboratory manager, a phone call down the list is required to locate the first person available.

EMERGENCY TELEPHONE NUMBERS:

	OFFICE:	HOME:	BEEPER:
Geoffrey Brock, Director	685-1402	849-0232	507-0022
Jung Choi, Manager, SRA	685-1407	676-4891	507-0023
Gary Burlingame, Supervisor, SRA	685-1417	333-2171	none
Patrick Frazer, Project Biologist, SRA	685-1456	425-1424	507-0025
Eugene Gasiewski, Manager, Inorganics Branch	685-1404	722-0116	none
Joe Roman, Supervisor, Inorganics Branch	685-1409	342-6326	none
Cindy Rettig, Supervisor, Aquatic Biology Lab	685-1428	728-1982	none
Earl Peterkin, Supervisor, Organics Lab	685-1439	477-8113	none

PWD WATER TREATMENT PLANTS

SOURCE OR POTABLE WATER CONTAMINATION INCIDENT REPORT

☐ Delaware or Schuylkill River; flow ____ cfs ☐ Bx/QL/BL Intake ☐ Bx/QL/BL Plant

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Person Responding to Incident:
Name & Job Title: __________________________ ☐ Baxter ☐ Queen Lane ☐ Belmont
Date/time: __________________________________ ☐ IWU ☐ Other _____________

Person or Organization Initiating Information About the Contamination Incident:
Name & Job Title: ____________________ ☐ Chemist ☐ Ld Control ☐ BLS ☐ IWU ☐ Police
Date/time : _________ Location: _______________________ ☐ Plt Mgmt ☐ Stby Engr ☐ PaDEP

Contaminant Information:
Contaminant Type: ☐ Chemical ☐ Biological ☐ Radiological ☐ Toxic Compound ☐ Unknown
Intake Location Affected: ☐ Baxter ☐ Queen Lane ☐ Belmont ☐ Other _______________
Contaminant Source : ☐ Date/Time Observed ___________ Contact Name / # : ________________
Contaminant Flow : ☐ Continuous ☐ Slug ☐ ____ Gallons ☐ ____ Drums ☐ ____ Rate or hrs
Contaminant Clean-up Contact/Contractor name/#: ____

Cause of Incident/Type of Failure:
☐ **Highway Accident** ☐ **Storm Event** ☐ **Sewage Spill into River** ☐ **Loss of Power**
☐ **Sewage Treatment Plant Discharge** ☐ **Purposeful Act** ☐ **Other ________________________**

Water Treatment Plant Information:
☐ **RWB Elev. ______ ft./MG** ☐ **FWB Storage Elev. ______ ft./MG** ☐ **Trtmt Rate _______MGD**
☐ **Treatment Chemicals on Y/N** ☐ **Potassium Permanganate Y/N** ☐ **Powdered Carbon Y/N**
☐ **Contaminant Treated with** ☐ **KMnO4 dose; _____#/MG** ☐ **Carbon dose ; _____ #/MG**
☐ **Recommendation:** ☐ **Treat Contaminant** ☐ **Shut Down Intake** ☐ **Shut Down WT Plant**

Response: ☐ **Phone Response Only** ☐ **Site Visit Required** ☐ **Emergency Crew Dispatched**
Phone Calls: (Names and/or Agencies Contacted; Police, PaDEP, EPA, PWD)

No.	Date & Time	Person / # Contacted	Action Taken

Written description of incident, including remedial action, follow-up & recommendation:

Watershed Contaminant Incident Report (WsCIR.doc), Jan 2001

ADDENDUM #1 PHONE NUMBERS OR E-MAIL ADDRESSES CRITICAL			
	OFFICE #	**CELL OR PAGER #**	**E-MAIL ADDRESS**
Philadelphia Police Department	911		
24 Hour Hotline - City Hall Operator	(215) 686-4514/4515		
PWD Management			
Water Commissioner Bernard Brunwasser	(215) 685-6106	C - (215) 847-2995	Bernie.Brunwasser@Phila.Gov
Deputy Water Commissioner Debra McCarty	(215) 685-6102	C - (267) 278-8603	Debra.McCarty@Phila.Gov
Deputy Director of Operations Bruce Aptowicz	(215) 685-6205	C - (215) 828-0687	Bruce.Aptowicz@Phila.Gov
Water Treatment Plants Manager William Wankoff	(215) 685-6257	C - (267) 278-8601	William.Wankoff@Phila.Gov
Water Treatment Plant Managers			
Baxter WTP Manager - Kate Guest	(215) 685-8020	C - (215) 906-0150	Kate.Guest@Phila.Gov
Baxter WTP Process Control Room - 24 hour #	(215) 685-8055		
Belmont WTP Manager - John Muldowney	(215) 685-0200	C - (215) 906-0151	John.Muldowney@Phila.Gov
Belmont WTP Process Control Room - 24 hour #	(215) 685-0227		
Queen Lane WTP Manager - Jerry Kuziw	(215) 685-2101	C - (215) 906-1147	Jerry.Kuziw@Phila.Gov
Queen Lane WTP Process Control Room - 24 hour #	(215) 685-2117		
Industrial Wastes Unit			
IWU Manager Thomas Healey	(215) 685-6233	C - (215) 852-6289	Thomas.Healey@Phila.Gov
IWU 24 Hour Hotline via City Hall Operator	(215) 686-4514/5		
Load Control Center			
Load Control Center Manager George Kunkel	(215) 685-9635	C - (215) 906-9526	George.Kunkel@Phila.Gov
Load Control Center 24 Hour Hotline	(215) 685-9609		
Bureau of Laboratory Services			

ADDENDUM #1 **PHONE NUMBERS OR E-MAIL ADDRESSES**			**CRITICAL**
	OFFICE #	**CELL OR PAGER #**	**E-MAIL ADDRESS**
Director - Geoffrey Brock	(215) 685-1402	P - (215) 916-4690	Geoffrey .Brock@Phila.Gov
SRA Manager - Jung Choi	(215) 685-1407	C - (215) 906-6389	Jung.Choi@Phila.gov
PA Department of Environmental Protection			
Water Supply Manager Gerry Centofanti	1-(484) 250-5980	None	GCentofant@State.PA.US
24 Hour Hotline	1-(484) 250-5900		
Philadelphia Health Department			
24 Hour Hotline via City Hall Operator	(215) 686-4514/5		
Public Affairs Division			
General Manager Ed Grusheski	(215) 685-6110	P - (215) 916-5255	Ed.Grusheski@Phila.Gov
24 Hour Hotline via Emergency Desk	(215) 685-6300		
PWD Wholesale Customers			
Bucks County Water & Sewer Authority - Ben Jones	(215) 343-2538	None	BJones@BCWSA.Net
Bucks County Water & Sewer Authority - 24 hour #	(215) 343-3946		
Aqua Pennsylvania - Preston Luitweiler	1-(610) 645-1132	(610) 975-8468	JPLuitweiler@aquaamerica.com
Aqua Pennsylvania - 24 hour #	1-(610) 525-6370		
US Environ. Protection Agency - Region III			
24 Hour Hotline	(215) 814-9016		
PWD Water Quality Committee			
Bruce Aptowicz	(215) 685-6205	C - (215) 828-0687	Bruce.Aptowicz@Phila.Gov
Gary Burlingame	(215) 685-1417	None	Gary.Burlingame@Phila.Gov
Jung Choi	(215) 685-1407	C - (215) 906-6389	Jung.Choi@Phila.gov
J. Barry Davis	(215) 685-6116	None	J Barry.Davis@Phila.gov
Ed Grusheski	(215) 685-6110	P - (215) 916-5255	Ed.Grusheski@Phila.Gov

ADDENDUM #1 **PHONE NUMBERS OR E-MAIL ADDRESSES** **CRITICAL**			
	OFFICE #	**CELL OR PAGER #**	**E-MAIL ADDRESS**
Dr. Marguerite Hawkins	(215) 685-6741	P - (215) 435-5913	Marguerite.Hawkins@Phila.Gov
Paul Kohl	(215) 685-6320	None	Paul.Kohl@Phila.Gov
Debra McCarty	(215) 685-6102	C - (267) 278-8603	Debra.McCarty@Phila.Gov
Drew Mihocko	(215) 685-6203	C - (215) 397-8272	Drew.Mihocko@Phila.Gov
Leah Gaffney	(215) 685-4877	None	Leah.Gaffney@Phila.Gov
Matthew Smith	(215) 685-6318	None	Matthew.Smith@Phila.Gov
William Wankoff	(215) 685-6257	C - (267) 278-8601	William.Wankoff@Phila.Gov
Charles Zitomer	(215) 685-6209	C - (215) 852-6155	Charles.Zitomer@Phila.Gov

5.2.2 Alternative Supplies

In the event of a catastrophic event that renders one of both of PWD's river sources unusable, PWD developed a multiphase plan that will allow for continued supply of water (potable and non-potable) for up to an extended period of time. This plan involves implementing emergency pumping facilities to allow for available supply to be distributed throughout the entire city, if one supply is still usable. Or, if both supplies are affected the Department will proceed with the initiation of a broad public awareness campaign to alert consumers not to ingest the tap water, filling and isolation of reservoirs and tanks as much as possible prior to the shutting of the intake(s), distribution of stored/potable water via tank trucks, and treatment and distribution of contaminated water for uses such as fire fighting. This procedure is detailed in the City of Philadelphia – Water Department's Emergency Operational Procedure of the Water Supply System in Event of a Prolonged Raw Water Source Outage.

If the contamination event is projected to outlast the potable supply, the city would seek alternative supplies from neighboring purveyors. However, it is generally believed that any event of a magnitude sufficient to cause prolonged contamination of both the Schuylkill and Delaware River supplies would also be severe enough to affect the regional water supply and thereby leave the entire region in a water crisis.

Section 6. New Sources

The City of Philadelphia does not foresee a need to establish a new water supply in the Schuylkill River watershed. The City of Philadelphia's population has steadily declined over the past fifty years. It is expected that by the 2010 U.S. Census, Philadelphia will lose its place as the fifth largest city in the country to Phoenix, Arizona. PWD is currently exploring opportunities to sell water to distributors outside of the city limits.

Section 7. Schuylkill River Watershed Source Water Protection Objectives, Progress Indicators, & Implementation Tasks

PWD, along with regulatory agencies and upstream water suppliers all have a stake in implementing actions that will lead to an overall improvement in water quality, more specifically, to provide safe drinking water, restore impaired streams, and support aquatic life and recreation. PWD is committed to working as part of a collaborative network in achieving the overall goal: ***To ensure the integrity and affordability of the region's water supply for generations to come***.

PWD and upstream stakeholders will work to fulfill this overriding goal by completing the following seven objectives:

1. Establish the Schuylkill Action Network as a permanent watershed-wide organization charged with identifying problems and prioritizing projects and funding sources to bring about real improvement in water quality throughout the Schuylkill River watershed.

2. Create a long-term, sustainable fund to support restoration, protection, and education projects in the Schuylkill River watershed.

3. Increase public awareness of the Schuylkill River watershed's regional importance as a drinking water source.

4. Initiate changes in policies and decision-making that balance and integrate the priorities of both the Safe Drinking Water Act and Clean Water Act.

5. Establish the Early Warning System as a regional information sharing resource and promote its capabilities for water quality monitoring and improving emergency communication.

6. Reduce point source impacts to water quality.

7. Reduce non-point source impacts to water quality.

These objectives will be carried out by completing the implementation tasks identified in the next section. The progress made in achieving the objectives will be measured by checking them against the progress indicators also outlined in the next section. By defining the objectives of the protection plan and providing a means of measuring progress, there is a greater likelihood of success in reaching the overall goal. If all the objectives are addressed, PWD believes that the approach developed for the Schuylkill River can be a model for other watersheds for moving from assessment to protection. PWD and the SAN will demonstrate how sources of pollution can be managed on a watershed basis through a cooperative approach, coordinating actions under both the Safe Drinking Water Act and Clean Water Act.

7.1 Protection Plan Objectives, Progress Indicators, & Implementation Tasks

Objective 1: *Establish the Schuylkill Action Network as a permanent watershed-wide organization charged with identifying problems and prioritizing projects and funding sources to bring about real improvement in water quality throughout the Schuylkill River watershed***.**

Progress Indicators

- The continued existence of the SAN as a permanent watershed-wide organization, which includes organizations from throughout the watershed.
- Number of participating members and the diversity of the member organizations.
- Number of meetings held and the number of agencies in attendance at these meetings.
- SAN's goals and measures.
- Progress report on the work completed by the SAN and restoration plan.
- Number of restoration projects initiated and completed.
- Adoption of a coordinated funding effort among watershed-wide funders.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Refine the framework of the SAN to ensure that all sources impacting the watershed are properly addressed through workgroup activities.
- Target specific audiences to increase membership and general awareness of the SAN.
- Continue to host regular meetings and workshops tailored to the needs of the watershed.
- Develop and work to achieve workgroup goals, measures, and priorities.
- Prioritize and implement protection projects.
- Identify and coordinate sources of funding and oversee completion of restoration projects.
- Develop a framework and business plan for a permanent organization.

PWD Tasks

- Participate on the SAN's Executive Steering Committee, Planning Committee, and relevant workgroups.
- Provide technical support for prioritizing restoration and protection projects in the watershed.
- Support the development of a framework and business plan for a permanent organization.

Objective 2: *Create a long-term, sustainable fund to support restoration, protection, and education projects in the Schuylkill River watershed.*

Progress Indicators

- Number of organizations contributing to the fund.
- Total dollar amount generated and the amount spent on projects annually.
- Number of long-term monetary commitments received through foundations, water suppliers, industries, and municipalities.
- Total dollar amounts received in congressional appropriations.
- Process created for approving and prioritizing projects and dispersing funds.
- Number of grants awarded annually in the watershed.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Obtain long-term financial commitments so that at least $5 million is available on an annual basis for the Schuylkill River watershed by 2010.
- Develop a process to approve and prioritize projects and disperse funds to the organizations implementing the restoration projects.
- Successfully implement the Targeted Watersheds Initiative Grant.

PWD Tasks

- Conduct feasibility study to identify potential fund structures.
- Work with partners and build on existing relationships to lobby for a Congressional appropriation for the Schuylkill River watershed.
- Provide technical assistance to watershed partners during grant application process.

- Successfully implement the Targeted Watersheds Initiative Grant.

Objective 3: *Increase public awareness of the Schuylkill River watershed's regional importance as a drinking water source.*

<u>Progress Indicators</u>

- Number of water suppliers that are participating members of the SAN.
- Number of municipalities that are participating members of the SAN.
- Number of EACs in the watershed.
- Number of golf courses certified by Audubon International.
- Number of "Clean Water Partners" and "Corporate Environmental Stewardship" workshops held by Partnership for the Delaware Estuary and the number of businesses participating in the program.
- Number of highway departments using alternative road salt technology.
- Number of visitors to the SAN website.
- Number of visitors to the Fairmount Waterworks Interpretive Center.
- Number of schools, farms, and businesses submitting nominations for SAN source water protection award.
- Number of communities addressing inadequate, illegal, or no sewer connection.
- Number of NPDES Phase II communities with a stormwater ordinance in place; stormwater ordinance includes a redevelopment component and is strictly enforced.
- Number of signs indicating a sensitive water supply area with a telephone number to call during an emergency.
- Number of workshops held to educate dischargers on their potential impacts to drinking water supplies.
- Number of permit and TMDL applications which include a source water protection component.
- Inclusion of drinking water protection priorities in land conservation decisions.

<u>Implementation Tasks (Five-Year Timeline)</u>

SAN Tasks

- Establish EACs in high priority protection areas.

- Develop award program for schools, farms, and businesses to receive recognition for their efforts in reducing stormwater impacts.
- Educate PennDoT and municipalities on alternative road salt technologies.
- Educate communities with inadequate, illegal, or no sewer connection about funding opportunities to construct treatment facilities through Pennvest.
- Educate municipalities on the MS4 requirements and provide assistance with developing their stormwater ordinances.
- Educate designers, developers, municipal engineers, and attorneys about stormwater BMPs.
- Install signage throughout the watershed identifying sensitive water supply areas that include emergency contact information.
- Educate the public about their role in source water protection.
- Promote the importance of the Schuylkill River as a regional resource and drinking water supply.

PWD Tasks

- Help prioritize target communities for EACs.
- Expand golf course certification program to areas outside the City of Philadelphia.
- Continue to update SAN website and further develop resources available.
- Continue involvement with developing exhibits on source water protection at the Fairmount Water Works Interpretive Center.
- Develop Watershed Technology Center to provide a regional technical resource for watershed management issues.
- Integrate the work of PWD's CSO, Source Water, and Stormwater Programs and prioritize projects and efforts that meet the priorities of all three.
- Educate the citizens of the City of Philadelphia about their role in source water protection.
- Promote the importance of the Schuylkill River as a regional resource and drinking water supply.

Objective 4: *Initiate changes in policies and decision-making that balance and integrate the priorities of both the Safe Drinking Water Act and Clean Water Act*.

Progress Indicators

- Number of TMDLs established that include drinking water considerations during the development process.
- Number of major NPDES dischargers required to report *Cryptosporidium* results as part of permit requirements.
- Number of NPDES dischargers reporting to the Early Warning System as part of their permit requirements.
- Number of permits issued with a watershed-wide approach.
- Number of dischargers experiencing SSOs reporting to the EWS.
- Number of emerging contaminants monitored for on a routine basis.
- Number of streams listed as impaired for potable water supply.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Prioritize water supply areas for TMDL development.
- Collect water quality data on *Cryptosporidium* at the intakes and develop a database for this information; Monitor *Cryptosporidium* discharges to establish permissible discharge levels and evaluate proper control techniques to transfer this information to WWTPs for implementation.
- Perform study to explore the inclusion of monitoring *Cryptosporidium* as part of the NPDES permit requirement.
- Require dischargers experiencing overflows from SSOs to report to the EWS.
- Promote the use of the EWS as a means of initiating policy changes in the permit requirements of dischargers.
- Develop/obtain electronic tracking database of CSO and SSO discharge events and use USGS monitoring information to establish baseline impacts of CSO and SSO discharges and develop reduction targets.

PWD Tasks

- Develop a program to meet the TMDL requirement in the Wissahickon Creek.

- Conduct a case study for watershed-based permitting and nutrient trading.
- Develop a regional bacteria source tracking program to identify potential sources in the watershed.
- Develop a program to identify, prioritize, and monitor emerging contaminants in the watershed.

Objective 5: *Establish the Early Warning System as a regional information sharing resource and promote its capabilities for water quality monitoring and improving emergency communication.*

Progress Indicators

- Number of water suppliers, dischargers, and industries participating in the EWS program.
- Percentage of permitted discharges and SSOs reported to the EWS.
- Number of workshops held to educate dischargers on their potential impacts to drinking water supplies.
- The creation of a training program for potential EWS users.
- Number of events reported to the EWS.
- Number of visitors to the EWS website.
- Number of water quality monitoring stations.
- New geographic areas covered by the system.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Promote the importance of increased communication between waters suppliers and dischargers during SAN activities and through workshops.
- Promote the use of the EWS as a means of initiating policy changes in the permit requirements of dischargers.

PWD Tasks

- Continue to identify water suppliers, dischargers, and industries who should participate in EWS. All upstream dischargers should be required to report to the EWS.
- Promote use of the EWS by water utility personnel, emergency responders, government agencies, and industry representatives to share information about water quality events.

- Promote the use of and create a training program on how to use the emergency notification system.
- Manage daily operations of the EWS.
- Develop a sustainable funding source for the EWS possibly through a grant award or rate structure.

Objective #6: *Reduce point source impacts to water quality*.

Progress Indicators

- Concentrations of nitrate, phosphorus, fecal coliforms, *Cryptosporidium*, total organic carbon, total suspended solids, and metals and levels of pH and dissolved oxygen during dry weather and low flow events.
- Number of communities addressing inadequate, illegal, or no sewer connection.
- Number of major dischargers whose permits require information on *Cryptosporidium* concentrations.
- Number of gallons of AMD treated or diverted through implemented projects.
- Number of miles of streambank fencing and riparian buffers.
- Reduction of discharge violations throughout the watershed.
- Number of permits covered under a watershed-wide permit approach.
- Presence of healthy fish below discharges and remediation sites.
- Number of sources in bacteria source tracking database.
- Number of emerging contaminants monitored for on a routine basis.
- Number of acres of land preserved based upon location as a source water protection area.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Collect water quality data on *Cryptosporidium* at the intakes and develop a database for this information; Monitor *Cryptosporidium* discharges to establish permissible discharge levels and evaluate proper control techniques to transfer this information to WWTPs for implementation.

- Review existing water quality data, identify gaps in monitoring data, and make recommendations for future monitoring activities.
- Design and implement a voluntary, capacity self-assessment program for dischargers and ensure that all municipal systems in the watershed have updated Act 537 plans.
- Provide assistance to municipalities with developing ordinances requiring the clean-out of septic systems.
- Perform study to explore the inclusion of monitoring *Cryptosporidium* as part of the NPDES permit requirement.
- Perform necessary studies to identify best remediation measures at the Pine Knot, Pine Forest, and Reevesdale South Dip Tunnel AMD sites; Secure commitment from land owners allowing implementation of remediation measures on their property; Secure funding for remediation projects; Implement AMD remediation measures to reduce metals in the Upper Schuylkill watershed by 50%; Monitor water quality and flow at AMD remediation sites and reprioritize discharges based upon results.
- Prioritize agricultural areas and work with farming community to construct streambank fencing and riparian buffers along 40 miles of impaired stream reaches; Monitor for bacteria and nutrients at BMP locations. Ultimately, all streams bordering agricultural lands will be buffered.

PWD Tasks

- Continue sewer maintenance program to prevent SSOs.
- Continue to identify and fix defective laterals and cross-connections.
- Minimize CSOs through increased system storage and BMP implementation.
- Develop a program to meet the TMDL requirement in the Wissahickon Creek.
- Develop a regional bacteria source tracking program to identify potential sources in the watershed.
- Develop a program to identify, prioritize, and monitor emerging contaminants in the watershed.

Objective #7: Reduce non-point source impacts to water quality.

<u>Progress Indicators</u>

- Concentrations of *Cryptosporidium*, fecal coliforms, total suspended solids, nitrate, phosphorus, and total organic carbon during wet weather events.

- Number of NPDES Phase II communities with a stormwater ordinance in place; Stormwater ordinance includes a redevelopment component and is strictly enforced.
- Number of subwatersheds with an updated Act 167 Plan.
- Number of new, large development projects with a low impact development component and effective stormwater management.
- Total number of square miles of impervious cover.
- Number and location of effective BMPs and estimated TSS load reductions.
- Number of CSOs and SSOs.
- Number of miles of streambank fencing and riparian buffers.
- Total number of farms with a completed conservation plan.
- Number of acres of land preserved based upon location as a source water protection area.
- Annual estimated Canada geese population in the watershed.
- Number of emerging contaminants identified and monitored for on a routine basis.

Implementation Tasks (Five-Year Timeline)

SAN Tasks

- Conduct routine monitoring for *Cryptosporidium*, fecal coliforms, total suspended solids, nitrate, phosphorus, and total organic carbon during wet weather events.
- Encourage stormwater management programs through MS4 and Act 167 Programs.
- Identify areas for retrofitting/restoration of existing stormwater controls and educate designers, developers, municipal engineers, and attorneys about stormwater BMPs.
- Obtain GIS land use information and identify available prioritization models to identify and map areas under greatest threat of future development.
- Develop/obtain electronic tracking database of CSO and SSO discharge events and use USGS monitoring information to establish baseline impacts of CSO and SSO discharges and develop reduction targets.
- Prioritize agricultural areas and work with farming community to construct streambank fencing and riparian buffers along 40 miles of impaired stream reaches; Monitor for nutrients at BMP locations. Ultimately, all streams bordering agricultural lands will be buffered.

- Complete farm conservation plans for at least 15% of the farms within the watershed.

PWD Tasks

- Develop a program to meet the TMDL requirement in the Wissahickon Creek.
- Create an inventory of BMPs and restoration projects completed by PWD and its partners throughout the watershed and use literature and monitoring to understand and estimate the impact of these efforts.
- Identify locations on public lands in the Wissahickon and Lower Schuylkill subwatersheds to construct ten BMPs.
- Continue sewer maintenance program to prevent SSOs.
- Continue to identify and fix defective laterals and cross-connections.
- Minimize CSOs through increased system storage and BMP implementation.
- Develop a regional bacteria source tracking program to identify potential sources in the watershed.
- Develop a regional management plan to address the exploding population of non-migratory Canada geese.
- Develop a program to identify, prioritize, and monitor emerging contaminants in the watershed.

APPENDIX:

1. **Priority Non-Point Source Locations and Upcoming Projects in the Schuylkill Watershed**
2. **List of Acronyms**
3. **Works Cited**

Non-Point Source Locations & Upcoming Projects in the Schuylkill River Watershed

The following tables identify the priority non-point source location results included in Section 3.1.3 of this source water protection plan as well as the projects discussed in Sections 3.2 and 3.3 to be implemented by PWD and the SAN. The purpose of these tables is to connect the results of the source prioritization to the projects identified for implementation. In some cases a specific project could not be connected to a specific subshed. In these instances a "shedwide" project, which includes educational projects, studies, and planning efforts will be used to address the impacts of these non-point sources.

Table 1 Priority Non-Point Source Locations for Combined Parameters & Upcoming Projects in the Schuylkill Watershed

Source ID	Source Name	Fecal Coliform (col/day)	Crypto (oocysts/ day)	Nitrate (lbs./day)	Phosphorus (lbs./day)	TSS (lbs./day)	TOC (lbs./day)	Intake Weight (%)	Zone A	Score	Project Name
90236	Tulpehocken Creek-236	1.037E+12	1.548E+08	2.351E+02	4.592E+01	2.464E+04	3.769E+02	80.00	0	1	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90008	Wissahickon Creek-008	5.220E+12	1.173E+08	1.355E+02	2.074E+01	1.177E+04	6.651E+02	62.95	2	2	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90024	Stony Creek-024	4.272E+12	9.204E+07	1.090E+02	1.675E+01	8.298E+03	4.904E+02	65.23	3	3	Norristown High School, Norristown Farm Park
90289	Schuylkill River-289	1.013E+12	8.122E+07	8.868E+01	1.642E+01	9.942E+03	2.791E+02	78.33	3	4	Shedwide
90003	Schuylkill River-003	9.316E+12	1.697E+08	1.895E+02	2.370E+01	6.216E+03	1.088E+03	26.05	0	5	Manayunk Canal – Aeration and Flow, Main and Shurs Elimination, Dobson's Run Elimination, Belmont Meadow Extension, On-Line Monitoring at WTP Intakes
90027	Trout Creek-027	2.323E+12	4.083E+07	4.978E+01	6.587E+00	5.062E+03	2.941E+02	67.50	4	6	Shedwide
90265	Mill Creek-265	9.316E+10	9.311E+07	1.264E+02	2.591E+01	1.543E+04	2.217E+02	78.29	1	7	Shedwide
90164	Schuylkill River-164	1.679E+12	4.893E+07	5.751E+01	8.318E+00	5.348E+03	2.566E+02	76.11	3	8	Shedwide
90190	Hay Creek-190	2.093E+11	4.940E+06	6.566E+00	9.952E-01	4.806E+02	3.699E+01	78.50	5	9	Shedwide
90020	Schuylkill River-020	3.611E+12	7.000E+07	8.839E+01	1.034E+01	3.552E+03	4.762E+02	62.95	2	10	Shedwide
90153	Mingo Creek-153	6.881E+11	2.385E+07	2.455E+01	4.238E+00	2.204E+03	9.780E+01	74.51	4	11	Spring-Ford High School
90282	Schuylkill River-282	1.084E+12	1.036E+08	1.091E+02	2.063E+01	1.275E+04	2.946E+02	78.29	0	12	Shedwide
90045	Towamencin Creek-045	2.024E+12	3.438E+07	4.112E+01	5.869E+00	2.047E+03	2.042E+02	73.29	3	13	Shedwide
90193	Schuylkill River-193	2.884E+12	6.632E+07	7.451E+01	9.568E+00	5.936E+03	3.993E+02	78.29	1	14	Shedwide
90283	Irish Creek-283	8.157E+10	1.079E+08	1.005E+02	2.160E+01	1.489E+04	2.020E+02	78.29	0	15	Shedwide
90248	Moselem Creek-248	2.695E+11	6.225E+07	9.933E+01	1.973E+01	1.049E+04	1.710E+02	78.29	1	16	Shedwide
90135	French Creek-135	1.434E+12	3.641E+07	3.631E+01	5.644E+00	3.033E+03	1.906E+02	73.29	3	17	Shedwide
90025	Crow Creek-025	1.270E+12	2.006E+07	2.472E+01	3.427E+00	1.035E+03	1.365E+02	67.50	4	18	Shedwide
90267	Maiden Creek-267	4.497E+10	7.495E+07	7.580E+01	1.583E+01	1.061E+04	1.735E+02	78.29	1	19	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing,

											Cattle Crossing Construction
90042	Skippack Creek-042	9.261E+11	3.237E+07	3.239E+01	5.636E+00	3.052E+03	1.483E+02	73.29	3	20	Evansburg Park
90154	Schuylkill River-154	1.889E+12	4.738E+07	5.407E+01	7.284E+00	3.708E+03	2.529E+02	74.51	2	21	Shedwide
90049	Perkiomen Creek-049	1.057E+12	2.876E+07	3.033E+01	4.674E+00	2.737E+03	1.376E+02	73.29	3	22	Rambo Park
90165	Manatawny Creek-165	7.492E+11	1.966E+07	2.151E+01	3.014E+00	3.748E+03	1.018E+02	76.11	3	23	Shedwide
90277	Ontelaunee Creek-277	8.623E+10	8.678E+07	9.102E+01	1.878E+01	1.239E+04	2.186E+02	78.29	0	24	Shedwide
90167	Ironstone Creek-167	2.744E+11	2.557E+07	2.240E+01	4.497E+00	3.012E+03	8.097E+01	76.29	3	25	Shedwide
90213	Spring Creek-213	3.410E+11	8.088E+07	9.158E+01	1.859E+01	1.153E+04	1.888E+02	80.00	0	26	Shedwide
90234	Tulpehocken Creek-234	3.783E+11	7.342E+07	9.259E+01	1.878E+01	1.099E+04	1.820E+02	80.00	0	27	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90007	Wissahickon Creek-007	2.630E+12	4.098E+07	6.029E+01	8.229E+00	2.778E+03	3.005E+02	62.95	2	28	Erdenheim Farms, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90009	Sandy Run-009	2.342E+12	4.348E+07	5.505E+01	7.953E+00	3.676E+03	3.003E+02	62.95	2	29	Shedwide
90163	Sprogles Run-163	7.746E+11	1.701E+07	1.827E+01	2.741E+00	1.509E+03	9.511E+01	76.11	3	30	Brookside Country Club
90224	Little Northkill Creek-224	5.189E+10	7.857E+07	8.718E+01	1.829E+01	1.161E+04	1.568E+02	80.00	0	31	Shedwide
90105	Schuylkill River-105	1.648E+12	3.767E+07	4.639E+01	5.952E+00	2.727E+03	2.175E+02	73.29	2	32	Shedwide
90238	Schuylkill River-238	2.495E+12	6.892E+07	7.896E+01	1.141E+01	7.190E+03	3.679E+02	78.29	0	33	Shedwide
90044	Zacharias Creek-044	3.042E+11	2.032E+07	1.971E+01	3.825E+00	2.387E+03	6.837E+01	73.29	3	34	Shedwide
90035	Valley Creek-035	1.431E+12	3.720E+07	4.266E+01	6.633E+00	4.837E+03	2.206E+02	67.50	2	35	Shedwide
90051	Lodal Creek-051	3.553E+11	1.809E+07	1.769E+01	3.250E+00	1.990E+03	7.096E+01	73.29	3	36	Shedwide
90233	Mill Creek-233	1.532E+10	7.706E+07	7.479E+01	1.607E+01	1.087E+04	1.467E+02	80.00	0	37	Shedwide
90052	Perkiomen Creek-052	4.631E+11	1.570E+07	1.545E+01	2.578E+00	1.415E+03	6.653E+01	73.29	3	38	Shedwide
90295	Schuylkill River-295	1.308E+12	6.183E+07	7.633E+01	1.243E+01	8.845E+03	2.995E+02	78.29	0	39	Regional WWTP in Upper Schuylkill
90271	Maiden Creek-271	1.290E+10	5.046E+07	5.226E+01	1.116E+01	7.388E+03	1.456E+02	78.29	1	40	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction

Table 2 Priority Non-Point Source Locations for *Cryptosporidium* & Upcoming Projects in the Schuylkill Watershed

Source ID	Source Name	Crypto (oocysts/ day)	Intake Weight (%)	Zone A	Score	Project Name
90236	Tulpehocken Creek-236	1.55E+08	80.00	0	1	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90289	Schuylkill River-289	8.12E+07	78.33	3	2	Shedwide
90024	Stony Creek-024	9.20E+07	65.23	3	3	Norristown High School, Norristown Farm Park
90008	Wissahickon Creek-008	1.17E+08	62.95	2	4	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90027	Trout Creek-027	4.08E+07	67.50	4	5	Shedwide
90190	Hay Creek-190	4.94E+06	78.50	5	6	Shedwide
90003	Schuylkill River-003	1.70E+08	26.05	0	7	Manayunk Canal – Aeration and Flow, Main and Shurs Elimination, Dobson's Run Elimination, Belmont Meadow Extension, On-Line Monitoring at WTP Intakes
90164	Schuylkill River-164	4.89E+07	76.11	3	8	Shedwide
90265	Mill Creek-265	9.31E+07	78.29	1	9	Shedwide
90153	Mingo Creek-153	2.38E+07	74.51	4	10	Spring-Ford High School
90283	Irish Creek-283	1.08E+08	78.29	0	11	Shedwide
90025	Crow Creek-025	2.01E+07	67.50	4	12	Shedwide
90282	Schuylkill River-282	1.04E+08	78.29	0	13	Shedwide
90020	Schuylkill River-020	7.00E+07	62.95	2	14	Shedwide
90135	French Creek-135	3.64E+07	73.29	3	15	Shedwide
90045	Towamencin Creek-045	3.44E+07	73.29	3	16	Shedwide
90042	Skippack Creek-042	3.24E+07	73.29	3	17	Evansburg Park
90267	Maiden Creek-267	7.49E+07	78.29	1	18	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90049	Perkiomen Creek-049	2.88E+07	73.29	3	19	Rambo Park
90167	Ironstone Creek-167	2.56E+07	76.29	3	20	Shedwide
90154	Schuylkill River-154	4.74E+07	74.51	2	21	Shedwide
90193	Schuylkill River-193	6.63E+07	78.29	1	22	Shedwide
90165	Manatawny Creek-165	1.97E+07	76.11	3	23	Shedwide
90044	Zacharias Creek-044	2.03E+07	73.29	3	24	Shedwide
90277	Ontelaunee Creek-277	8.68E+07	78.29	0	25	Shedwide
90163	Sprogles Run-163	1.70E+07	76.11	3	26	Brookside Country Club
90248	Moselem Creek-248	6.22E+07	78.29	1	27	Shedwide
90051	Lodal Creek-051	1.81E+07	73.29	3	28	Shedwide

90213	Spring Creek-213	8.09E+07	80.00	0	29	Shedwide
90052	Perkiomen Creek-052	1.57E+07	73.29	3	30	Shedwide
90105	Schuylkill River-105	3.77E+07	73.29	2	31	Shedwide
90224	Little Northkill Creek-224	7.86E+07	80.00	0	32	Shedwide
90046	West Branch Skippack Creek-046	1.36E+07	73.29	3	33	Shedwide
90209	Plum Creek-209	8.00E+07	78.29	0	34	Shedwide
90065	Swamp Creek-065	1.24E+07	73.29	3	35	Shedwide
90233	Mill Creek-233	7.71E+07	80.00	0	36	Shedwide
90009	Sandy Run-009	4.35E+07	62.95	2	37	Shedwide
90050	Schoolhouse Run-050	9.42E+06	73.29	3	38	Shedwide
90269	Maiden Creek-269	5.17E+07	78.29	1	39	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90234	Tulpehocken Creek-234	7.34E+07	80.00	0	40	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction

Table 3 Priority Non-Point Source Locations for Fecal Coliform & Upcoming Projects in the Schuylkill Watershed

Source ID	Source Name	Fecal Coliform (col/day)	Intake Weight (%)	Zone A	Score	Project Name
90024	Stony Creek-024	4.27E+12	65.23	3	1	Norristown High School, Norristown Farm Park
90008	Wissahickon Creek-008	5.22E+12	62.95	2	2	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90027	Trout Creek-027	2.32E+12	67.50	4	3	Shedwide
90190	Hay Creek-190	2.09E+11	78.50	5	4	Shedwide
90003	Schuylkill River-003	9.32E+12	26.05	0	5	Manayunk Canal – Aeration and Flow, Main and Shurs Elimination, Dobson's Run Elimination, Belmont Meadow Extension, On-Line Monitoring at WTP Intakes
90025	Crow Creek-025	1.27E+12	67.50	4	6	Shedwide
90153	Mingo Creek-153	6.88E+11	74.51	4	7	Spring-Ford High School
90045	Towamencin Creek-045	2.02E+12	73.29	3	8	Shedwide
90164	Schuylkill River-164	1.68E+12	76.11	3	9	Shedwide
90020	Schuylkill River-020	3.61E+12	62.95	2	10	Shedwide
90135	French Creek-135	1.43E+12	73.29	3	11	Shedwide
90289	Schuylkill River-289	1.01E+12	78.33	3	12	Shedwide
90049	Perkiomen Creek-049	1.06E+12	73.29	3	13	Rambo Park
90042	Skippack Creek-042	9.26E+11	73.29	3	14	Evansburg Park
90163	Sprogles Run-163	7.75E+11	76.11	3	15	Brookside Country Club
90165	Manatawny Creek-165	7.49E+11	76.11	3	16	Shedwide
90007	Wissahickon Creek-007	2.63E+12	62.95	2	17	Erdenheim Farms, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90154	Schuylkill River-154	1.89E+12	74.51	2	18	Shedwide
90039	Mine Run-039	5.83E+11	73.29	3	19	Shedwide
90193	Schuylkill River-193	2.88E+12	78.29	1	20	Shedwide
90009	Sandy Run-009	2.34E+12	62.95	2	21	Shedwide
90052	Perkiomen Creek-052	4.63E+11	73.29	3	22	Shedwide
90167	Ironstone Creek-167	2.74E+11	76.29	3	23	Shedwide
90046	West Branch Skippack Creek-046	3.66E+11	73.29	3	24	Shedwide
90051	Lodal Creek-051	3.55E+11	73.29	3	25	Shedwide
90105	Schuylkill River-105	1.65E+12	73.29	2	26	Shedwide
90044	Zacharias Creek-044	3.04E+11	73.29	3	27	Shedwide

90038	Perkiomen Creek-038	2.91E+11	73.29	3	28	Shedwide
90018	Plymouth Creek-018	2.12E+12	62.95	2	29	Shedwide
90050	Schoolhouse Run-050	2.77E+11	73.29	3	30	Shedwide
90040	Perkiomen Creek-040	2.59E+11	73.29	3	31	Shedwide
90041	Skippack Creek-041	2.11E+11	73.29	3	32	Shedwide
90065	Swamp Creek-065	1.12E+11	73.29	3	33	Shedwide
90034	Little Valley Creek-034	1.62E+12	67.50	2	34	Shedwide
90035	Valley Creek-035	1.43E+12	67.50	2	35	Shedwide
90012	Sandy Run-012	1.49E+12	62.95	2	36	Shedwide
90004	Wissahickon Creek-004	1.45E+12	62.95	2	37	Carpenter's Woods, Bells Mill Run and Gorgas Lane Plunge Pool, Monastery Stables, W.B. Saul High School, Saylor's Grove, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking, E&S Inspector Program
90321	Mud Run-321	3.60E+11	78.87	2	38	Shedwide
90316	Tumbling Run-316	1.70E+10	79.24	2	39	Shedwide
90291	Stony Creek-291	1.31E+09	78.31	2	40	Shedwide

Table 4 Priority Non-Point Source Locations (Nutrients) & Upcoming Projects in the Schuylkill Watershed

Source ID	Source Name	Nitrate (lbs./day)	Phosphorus (lbs./day)	Intake Weight (%)	Zone A	Score	Project Name
90236	Tulpehocken Creek-236	2.351E+02	4.592E+01	80.00	0	1	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90289	Schuylkill River-289	8.868E+01	1.642E+01	78.33	3	2	Shedwide
90024	Stony Creek-024	1.090E+02	1.675E+01	65.23	3	3	Norristown High School, Norristown Farm Park
90190	Hay Creek-190	6.566E+00	9.952E-01	78.50	5	4	Shedwide
90008	Wissahickon Creek-008	1.355E+02	2.074E+01	62.95	2	5	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90265	Mill Creek-265	1.264E+02	2.591E+01	78.29	1	6	Shedwide
90027	Trout Creek-027	4.978E+01	6.587E+00	67.50	4	7	Shedwide
90164	Schuylkill River-164	5.751E+01	8.318E+00	76.11	3	8	Shedwide
90248	Moselem Creek-248	9.933E+01	1.973E+01	78.29	1	9	Shedwide
90045	Towamencin Creek-045	4.112E+01	5.869E+00	73.29	3	10	Shedwide
90042	Skippack Creek-042	3.239E+01	5.636E+00	73.29	3	11	Evansburg Park
90049	Perkiomen Creek-049	3.033E+01	4.674E+00	73.29	3	12	Rambo Park
90167	Ironstone Creek-167	2.240E+01	4.497E+00	76.29	3	13	Shedwide
90020	Schuylkill River-020	8.839E+01	1.034E+01	62.95	2	14	Shedwide
90044	Zacharias Creek-044	1.971E+01	3.825E+00	73.29	3	15	Shedwide
90267	Maiden Creek-267	7.580E+01	1.583E+01	78.29	1	16	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90051	Lodal Creek-051	1.769E+01	3.250E+00	73.29	3	17	Shedwide
90282	Schuylkill River-282	1.091E+02	2.063E+01	78.29	0	18	Shedwide
90154	Schuylkill River-154	5.407E+01	7.284E+00	74.51	2	19	Shedwide
90052	Perkiomen Creek-052	1.545E+01	2.578E+00	73.29	3	20	Shedwide
90283	Irish Creek-283	1.005E+02	2.160E+01	78.29	0	21	Shedwide
90046	West Branch Skippack Creek-046	1.243E+01	2.204E+00	73.29	3	22	Shedwide
90065	Swamp Creek-065	1.081E+01	2.214E+00	73.29	3	23	Shedwide
90038	Perkiomen Creek-038	8.662E+00	9.368E-01	73.29	3	24	Shedwide
90105	Schuylkill River-105	4.639E+01	5.952E+00	73.29	2	25	Shedwide
90007	Wissahickon Creek-007	6.029E+01	8.229E+00	62.95	2	26	Erdenheim Farms, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90234	Tulpehocken Creek-234	9.259E+01	1.878E+01	80.00	0	27	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction

90213	Spring Creek-213	9.158E+01	1.859E+01	80.00	0	28	Shedwide
90193	Schuylkill River-193	7.451E+01	9.568E+00	78.29	1	29	Shedwide
90256	Sacony Creek-256	9.392E+01	1.834E+01	78.29	0	30	Shedwide
90009	Sandy Run-009	5.505E+01	7.953E+00	62.95	2	31	Shedwide
90277	Ontelaunee Creek-277	9.102E+01	1.878E+01	78.29	0	32	Shedwide
90224	Little Northkill Creek-224	8.718E+01	1.829E+01	80.00	0	33	Shedwide
90271	Maiden Creek-271	5.226E+01	1.116E+01	78.29	1	34	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90003	Schuylkill River-003	1.895E+02	2.370E+01	26.05	0	35	Manayunk Canal – Aeration and Flow, Main and Shurs Elimination, Dobson’s Run Elimination, Belmont Meadow Extension, On-Line Monitoring at WTP Intakes
90245	Maiden Creek-245	1.002E+02	1.587E+01	74.79	0	36	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90252	Sacony Creek-252	4.936E+01	1.001E+01	78.29	1	37	Shedwide
90269	Maiden Creek-269	4.593E+01	9.887E+00	78.29	1	38	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90233	Mill Creek-233	7.479E+01	1.607E+01	80.00	0	39	Shedwide
90235	Mill Creek-235	7.539E+01	1.500E+01	80.00	0	40	Shedwide

Table 5 Priority Non-Point Source Locations for Total Organic Carbon & Upcoming Projects in the Schuylkill Watershed

Source ID	Source Name	TOC (lbs./day)	Intake Weight (%)	Zone A	Score	Project Name
90027	Trout Creek-027	2.941E+02	67.50	4	1	Shedwide
90024	Stony Creek-024	4.904E+02	65.23	3	2	Norristown High School, Norristown Farm Park
90008	Wissahickon Creek-008	6.651E+02	62.95	2	3	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90289	Schuylkill River-289	2.791E+02	78.33	3	4	Shedwide
90164	Schuylkill River-164	2.566E+02	76.11	3	5	Shedwide
90003	Schuylkill River-003	1.088E+03	26.05	0	6	Manayunk Canal – Aeration and Flow, Main and Shurs Elimination, Dobson's Run Elimination, Belmont Meadow Extension, On-Line Monitoring at WTP Intakes
90020	Schuylkill River-020	4.762E+02	62.95	2	7	Shedwide
90045	Towamencin Creek-045	2.042E+02	73.29	3	8	Shedwide
90135	French Creek-135	1.906E+02	73.29	3	9	Shedwide
90042	Skippack Creek-042	1.483E+02	73.29	3	10	Evansburg Park
90049	Perkiomen Creek-049	1.376E+02	73.29	3	11	Rambo Park
90051	Lodal Creek-051	7.096E+01	73.29	3	12	Shedwide
90154	Schuylkill River-154	2.529E+02	74.51	2	13	Shedwide
90044	Zacharias Creek-044	6.837E+01	73.29	3	14	Shedwide
90052	Perkiomen Creek-052	6.653E+01	73.29	3	15	Shedwide
90039	Mine Run-039	5.413E+01	73.29	3	16	Shedwide
90193	Schuylkill River-193	3.993E+02	78.29	1	17	Shedwide
90046	West Branch Skippack Creek-046	4.848E+01	73.29	3	18	Shedwide
90007	Wissahickon Creek-007	3.005E+02	62.95	2	19	Erdenheim Farms, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90009	Sandy Run-009	3.003E+02	62.95	2	20	Shedwide
90038	Perkiomen Creek-038	4.654E+01	73.29	3	21	Shedwide
90105	Schuylkill River-105	2.175E+02	73.29	2	22	Shedwide
90018	Plymouth Creek-018	2.715E+02	62.95	2	23	Shedwide
90035	Valley Creek-035	2.206E+02	67.50	2	24	Shedwide
90034	Little Valley Creek-034	2.092E+02	67.50	2	25	Shedwide
90291	Stony Creek-291	5.162E+01	78.31	2	26	Shedwide
90265	Mill Creek-265	2.217E+02	78.29	1	27	Shedwide
90106	Pickering Creek-106	7.197E+01	39.90	3	28	Shedwide
90326	Schuylkill River-326	2.181E+02	78.31	1	29	Regional WWTP in Upper Schuylkill

90236	Tulpehocken Creek-236	3.769E+02	80.00	0	30	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90323	Mill Creek-323	1.854E+02	78.70	1	31	Shedwide
90047	Skippack Creek-047	2.119E+02	73.29	1	32	Skippack Creek Lansdale
90238	Schuylkill River-238	3.679E+02	78.29	0	33	Shedwide
90267	Maiden Creek-267	1.735E+02	78.29	1	34	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90248	Moselem Creek-248	1.710E+02	78.29	1	35	Shedwide
90271	Maiden Creek-271	1.456E+02	78.29	1	36	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90252	Sacony Creek-252	1.370E+02	78.29	1	37	Shedwide
90315	Schuylkill River-315	3.105E+02	78.29	0	38	Regional WWTP in Upper Schuylkill
90057	East Branch Perkiomen Creek-057	1.450E+02	73.29	1	39	Sellersville Fire Company
90069	Swamp Creek-069	1.436E+02	73.29	1	40	Shedwide

Table 6 Priority Non-Point Source Locations for Total Suspended Solids in the Schuylkill River Watershed

Source ID	Source Name	TSS (lbs./day)	Intake Weight (%)	Zone A	Score	Project Name
90236	Tulpehocken Creek-236	2.464E+04	80.00	0	1	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90289	Schuylkill River-289	9.942E+03	78.33	3	2	Shedwide
90265	Mill Creek-265	1.543E+04	78.29	1	3	Shedwide
90190	Hay Creek-190	4.806E+02	78.50	5	4	Shedwide
90024	Stony Creek-024	8.298E+03	65.23	3	5	Norristown High School, Norristown Farm Park
90008	Wissahickon Creek-008	1.177E+04	62.95	2	6	Lansdale Borough, Stormwater Ordinance Development, Wissahickon BMP Study, Wissahickon Feasibility Study, Bacteria Source Tracking
90164	Schuylkill River-164	5.348E+03	76.11	3	7	Shedwide
90283	Irish Creek-283	1.489E+04	78.29	0	8	Shedwide
90267	Maiden Creek-267	1.061E+04	78.29	1	9	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90248	Moselem Creek-248	1.049E+04	78.29	1	10	Shedwide
90167	Ironstone Creek-167	3.012E+03	76.29	3	11	Shedwide
90048	Doe Run-048	3.175E+03	73.29	3	12	Shedwide
90282	Schuylkill River-282	1.275E+04	78.29	0	13	Shedwide
90042	Skippack Creek-042	3.052E+03	73.29	3	14	Evansburg Park
90049	Perkiomen Creek-049	2.737E+03	73.29	3	15	Rambo Park
90277	Ontelaunee Creek-277	1.239E+04	78.29	0	16	Shedwide
90044	Zacharias Creek-044	2.387E+03	73.29	3	17	Shedwide
90224	Little Northkill Creek-224	1.161E+04	80.00	0	18	Shedwide
90213	Spring Creek-213	1.153E+04	80.00	0	19	Shedwide
90045	Towamencin Creek-045	2.047E+03	73.29	3	20	Shedwide
90038	Perkiomen Creek-038	2.032E+03	73.29	3	21	Shedwide
90051	Lodal Creek-051	1.990E+03	73.29	3	22	Shedwide
90040	Perkiomen Creek-040	1.614E+03	73.29	3	23	Shedwide
90234	Tulpehocken Creek-234	1.099E+04	80.00	0	24	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90065	Swamp Creek-065	1.522E+03	73.29	3	25	Shedwide
90233	Mill Creek-233	1.087E+04	80.00	0	26	Shedwide
90052	Perkiomen Creek-052	1.415E+03	73.29	3	27	Shedwide
90271	Maiden Creek-271	7.388E+03	78.29	1	28	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting, Streambank Fencing, Cattle Crossing Construction
90269	Maiden Creek-269	7.342E+03	78.29	1	29	Conservation Plan, Parcel Prioritization, Riparian Buffer Planting,

Source ID	Source Name	TSS (lbs./day)	Intake Weight (%)	Zone A	Score	Project Name
						Streambank Fencing, Cattle Crossing Construction
90209	Plum Creek-209	1.040E+04	78.29	0	30	Shedwide
90035	Valley Creek-035	4.837E+03	67.50	2	31	Shedwide
90154	Schuylkill River-154	3.708E+03	74.51	2	32	Shedwide
90287	Mill Creek-287	9.678E+03	78.29	0	33	Shedwide
90252	Sacony Creek-252	6.132E+03	78.29	1	34	Shedwide
90193	Schuylkill River-193	5.936E+03	78.29	1	35	Shedwide
90256	Sacony Creek-256	9.286E+03	78.29	0	36	Shedwide
90105	Schuylkill River-105	2.727E+03	73.29	2	37	Shedwide
90275	Kistler Creek-275	8.886E+03	78.29	0	38	Shedwide
90295	Schuylkill River-295	8.845E+03	78.29	0	39	Regional WWTP in Upper Schuylkill
90294	Pine Creek-294	8.704E+03	78.29	0	40	Shedwide

List of Acronyms

AMD	abandoned mine drainage
AST	Aboveground Storage Tank
BMP	best management practices
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CSO	combined sewer overflow
DMR	discharge monitoring report
DRBC	Delaware River Basin Commission
DVRPC	Delaware Valley Regional Planning Commission
EMC	event mean concentration
EPA	U.S. Environmental Protection Agency
EWS	Early Warning System
MGD	million gallons per day
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
PADEP	Pennsylvania Department of Environmental Protection
PCS	Permit Compliance System
PWD	Philadelphia Water Department
RCRA	Resource Conservation and Recovery Act
SAN	Schuylkill Action Network
SDWA	Safe Drinking Water Act
SRLM	Schuylkill River Loading Model
SSO	separate sewer overflow
SWAP	Source Water Assessment Project
SWMM	Storm Water Management Model
SWPP	Source Water Protection Plan
TM	Thematic Mapper
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TRI	Toxic Release Inventory
TSS	total suspended solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WTP	water treatment plant
WWTP	waste water treatment plant

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